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Nguyen

SCREENS, STEAM, AND PIPE DREAMS

THEY SAY THE EYES are the windows to a person's soul. I think the same holds true for a PC. The screen is the window to the overall experience ("soul") of a system, and everything else you do with it.

For years—actually, since forever—the focus of a new PC build has been its guts. What CPU, what graphics card, what storage system, and so on. It wasn't until very recently, with the advent of high refresh rate displays, that the thing we stare at all day (or night) is getting the celebrity status it deserves. But I've always recommended to people that their hard-earned cash should be invested in a good display first and foremost.

PC components change very quickly. As soon as you get that new GPU, you know a better one is going to be out very soon. This is not so with displays. A good display will probably outlast several generations of upgrades to your PC, and as your primary interface with your rig, will have tremendous impact on your experience. An investment in a quality display is an investment in your eyes. Do yourself a favor and spend the money on a good one.

On the system side, the world finally gets a good look at Steam Machines, the machines Valve has touted for three years to be the usurpers of Windows gaming systems. The delay? It's taken Valve quite a while to perfect its Steam Controller, which finally came out just recently. And SteamOS took a while, too.

Three years ago, I was in Valve's headquarters with a dry marker in my hand, standing in front of a whiteboard. I was carefully drawing out the reasoning on why, in my opinion, the whole Steam Machine project just didn't make much sense. There's a fundamental issue with Steam Machines: they only run games made for SteamOS. This means, essentially, you'll be unable to play all the newest big-hitter games, because they're only published for Windows.

Why would you install an OS, as a gamer, to play fewer games? Valve also made clear during a press event that it would not publish games exclusively for SteamOS. What about SteamOS's interface that's optimized for TV? That's available in the Windows Steam client as Big Picture Mode. And Valve has its Steam Link, which gives you that TV experience, while the rendering is handled by your PC. OK, so wait, you can dual-boot! No. You might as well just install Windows because all games are available for it. I know—performance, right? No. Recent benchmarks reveal SteamOS is significantly worse than Windows.

There's no difference in hardware. Steam Machines are just PCs running a crippled operating system. Just build the PC you want to build, to your own specifications, and install Windows. Valve's dream of dethroning Windows was just that. The same fact remains true now as it has for years: The best gaming system is a PC.

And the best Steam Machines are the ones that run Windows.

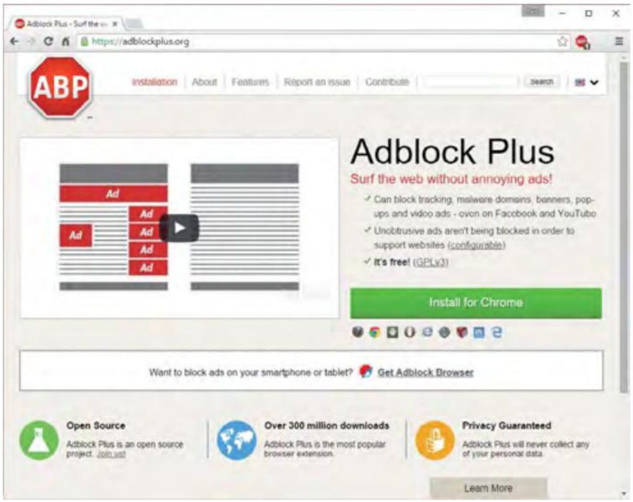
Tuan Nguyen is Maximum PC*'s editor-in-chief, also known as "the pointy end of the stick." He's been writing, marketing, and raising hell in the tech industry for 19 years.*

↘ submit your questions to: comments@maximumpc.com

THE NEWS

The Ad-Blocking Conundrum

The future of the web is at stake—who will come to its rescue?



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Surf the web without annoying ads!

- Can block tracking, malware domains, banners, pop-ups and video ads - even on Facebook and YouTube
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Over 300 million downloads
Adblock Plus is the most popular browser extension.

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Adblock Plus will never collect any of your personal data.

Ad-blockers cost online publishers tens of billions of dollars a year.

FOR YEARS, digital publishers have relied on online advertising to sustain their existence. Save for sites that sit behind a paywall and charge subscription fees, ads are the reason why the vast majority of content on the web is free. It's a business model that's worked to this point, but with the recent rise in the use of ad-blockers, publishers and readers are suddenly at odds with one another.

Part of the problem is that many site owners treat ad-blockers as a taboo subject, as though acknowledging their existence will make things worse. Others bring attention to the issue, but in negative ways, by drawing battle lines in the sand. For example, Yahoo recently made headlines for running an ad-blocking test that prevented users of its Yahoo Mail service from accessing their email until they disabled their ad-blockers.

We reached out to Eyeo, the maker of Adblock Plus, a popular, free ad-blocking extension for browsers, for thoughts on the subject. Ben Williams, communications manager for Eyeo, declined to address Yahoo's actions, but did offer some interesting thoughts on ad-blocking. "I would say that ad-blocking developed as a response to bad ads. However, blocking all ads is not the right approach," Williams told us. "Because of that, we developed Acceptable Ads—a certification process for better ads, which allows ads that met user-generated criteria to be whitelisted.... While we as an ad-blocker cannot solve the entire online monetization conundrum, Acceptable Ads has sparked a larger discussion that seems to be spurring on change in the industry."

Honest discussion is needed, as the online monetization conundrum is no small thing. The use of ad-blocking software is up almost 50 percent from last year, according to a PageRank report commissioned by Adobe. PageRank predicts that ad-blockers will deprive online publishers of over $20 billion in 2016, and that's just in the United States.

With so much money at stake, it's no surprise that some online publishers equate the use of ad-blockers to stealing. They argue that readers are breaking an unwritten contract, but there are valid reasons why ad-blockers exist. One of them is for security.

"While advertising is an effective way to generate revenue for websites, we have seen malware-infected ads (malvertising) as far back as 2007," Bruce Snell, cybersecurity and privacy director at Intel Security, told *Maximum PC*. "From a security perspective, ad-blocking software is a very good way to prevent malvertising from infecting your system with drive-by downloads or opening up countless pop-up ads. Dangerous ads aren't just a problem for PCs, as we see similar problems for Android."

It sounds like a lose-lose situation, although Snell argues that ad-blocking software would be less of a necessity if individual sites stopped using automated ad networks, or if ad providers started doing a better job of screening their content for malware.

At present, the only real compromise that exists is for ad-blocking users to willingly accept ads for sites they support. That's fine for now, but a sustainable solution will only be found via an open and honest dialogue by both sides. **–PL**

> “
> Save for sites that sit behind a paywall, ads are why most content on the web is free

CyberPower recommends Windows.

Windows 10

AMD

AMD RADEON GRAPHICS

AMD FX UNLOCKED

AMD A SERIES

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Cortana available in select markets at launch, experience may vary by region and device.
*External monitor must support HDMI input. [If Continuum-compatible accessory is not included, add: "Accessories sold separately."] **App availability and experience varies by device and market. Office 365 subscription required for some features. [1]Limited to select premium phones at launch.
Feature and app availability and experience may vary by market and device.
Windows Hello requires specialized hardware, including fingerprint reader, illuminated IR sensor or other biometric sensors.

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Work easy. Play hard. Windows

New Windows 10 devices could turn the tide.

MICROSOFT'S CELL PHONE SHARE HALVES

Windows 10 Mobile to the rescue?

DEMAND IN EMERGING markets helped boost smartphone sales to 353 million units in the third quarter of 2015, up 15.5 percent from the same quarter a year ago, according to the latest data by market research firm Gartner. Unfortunately for Microsoft, a fairly significant rise in overall phone sales hasn't translated into a bump in market share for its Windows-based handsets.

Actually, it's been just the opposite. There were fewer than 5.9 million Windows Phone shipments in the quarter, down from over nine million a year ago. As a result, Microsoft's measly share of the cell phone market was slashed from 3 percent a year ago to 1.7 percent at the end of Q3.

It continues to be a two-horse race between Android and iOS. Out of the 353 million smartphone sales in Q3, around 298.8 million were Android devices, and another 46 million were iPhones, putting Android and iOS's market share figures at 84.7 percent and 13.1 percent, respectively.

What's surprising about all this isn't that Android and iOS continue to dominate but that Microsoft's share fell off a tiny cliff after holding steady at 3 percent for several quarters. So why did it happen?

Multiple factors are at play. For one, consumers might be hesitant to purchase a Windows Phone device with Windows 10 for Mobile around the corner. And secondly, both Apple and Samsung launched new flagship devices in the past several months.

The good news for Microsoft is that the current market share data is based on its old Windows Phone platforms, not Windows 10 Mobile, which just became official with the launch of the Lumia 950 and Lumia 950 XL (both exclusive to AT&T). A release to the general public for installation on other phones isn't far off, either. The question is, will it make a difference? Gartner is skeptical. **–PL**

AMD ENDS DRIVER SUPPORT FOR PRE-GCN CARDS

AN EXCUSE TO UPGRADE

AMD'S ENTIRE BATCH of Radeon HD 6000 and Radeon HD 5000 series graphics cards are now considered legacy products, and will no longer receive driver updates. The same goes for Radeon HD 8000 (HD 8400 and below) and Radeon HD 7000 (HD 7600 and below) cards.

According to AMD, those cards have all reached "peak performance optimization," and there's nothing more to squeeze out of them. "These products have been moved to a legacy support model and no additional driver releases are planned. This change enables us to dedicate valuable engineering resources to developing new features and enhancements for graphics products based on the GCN architecture," AMD stated in a support document.

As one last hurrah, AMD made available two final drivers for pre-GCN graphics cards. One is the last ever WHQL-certified Catalyst release, version 15.7.1, and the other is an as-is beta of Radeon Software Crimson. **–PL**

ASUS CONFIRMS PLANS TO MAKE AR GLASSES

From the horse's mouth

ASUS CHAIRMAN JONNEY SHIH hinted last month that the company may make its own augmented reality (AR) glasses. Now CEO Jerry Shen has confirmed those plans, reporting that the product will be released in 2016. Shen made the revelation during an earnings webcast, saying that the company believes AR will be important for people's lives. He also told reporters that augmented reality headsets will be more useful than virtual reality headsets (such as the upcoming Facebook-backed Oculus Rift).

Last month, Shih indicated that Asus was working with Microsoft to produce a cheaper version of the latter company's upcoming HoloLens. While there's no definite confirmation that Asus will have any ties to Microsoft's AR headset, Asus may be following in the footsteps of Samsung, which is getting ready to release Gear VR, a $100 VR headset created with the help of Oculus VR. **–KP**

Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

TRIUMPHS

MILE-HIGH WI-FI
Gogo is giving in-flight Wi-Fi a boost in bandwidth that will allow video streaming to more than 40 devices.

KEY TO HAPPINESS
As of the latest update to Windows 10, upgraders can now activate a clean install using their Windows 7 or Windows 8/8.1 product key.

CABLE GUY
A Google engineer has been shaming lazy USB Type-C cable makers by leaving bad reviews on Amazon for cables that aren't up to spec.

TRAGEDIES

EXCLUSIVITY STINKS
Microsoft hamstrung the launch of its very first Windows 10 phones, the Lumia 950 and 950 XL, by making them exclusively available on AT&T.

CRAZY TALK
Apple CEO Tim Cook pondered why anyone would buy a traditional PC now that the iPad Pro is here, then trash-talked the Surface Book.

TRUTH HURTS
In a memo to employees, Comcast admitted that network congestion isn't the real reason for data caps.

Dave James

TECH TALK

AMD Gets Qt With Radeon Software Crimson Edition

"PERCEPTION IS REALITY." That's what Sasa Marinkovic, AMD's head of marketing, told me and a group of intrigued journalists at a recent dinner. Given that Terry Makedon, the man responsible for ATI's Catalyst software was sitting at the head of the table, we should have guessed what it was all about: a new era in AMD software.

There's a general perception that Catalyst Control Center is an awkward, sluggish, buggy beast. It's a perception that extends to the company's software in general, but this is something it's trying to change with the ground-up redesign of its graphics card software. The newly-released Crimson represents AMD's new commitment to its software support.

Part of that is Radeon Settings, the new name for AMD's driver control center, and the direct replacement for the aging Catalyst Control Center. The new design is slick, modern, and has ditched the obfuscating drop-down menus that littered the old CCC. Well... for the most part anyway.

Cleaning up the confusion of what goes where is a big part of AMD's new strategy. It doesn't just want hardcore techies digging into the software; it wants everyone to get in on the fun. That's the reasoning behind the uncluttered UI and the obvious name.

Huge changes have occurred behind the scenes, too. The move from using a .NET codebase to the new Qt modular framework could be massive.

Qt is a cross-platform framework, which Radeon Settings has been developed in from the ground up to utilize the platform's strengths. The most obvious benefit is the time it takes to boot from the desktop, plus how slick it feels when you're navigating it.

AMD has also been smart in choosing when the app springs into life when you boot. Using delaying algorithms, Radeon Settings can minimize its impact on the Windows boot process; AMD estimates that you'll see it hitting its optimum app boot time about five minutes after the OS loads.

Shader Caching is another new feature worth mentioning, primarily as something for older games and game engines. For DX10 and DX11 games, Shader Caching allows compiled shaders to be stored in a cache on the storage drive, making them quicker to access, and reducing computational load. This means shorter load times and fewer potential stutters in-game, when assets are being loaded in the background, or the rare occasions when the CPU is being a performance bottleneck.

AMD RADEON SETTINGS

AMD's Radeon Settings replaces the elderly Catalyst Control Center.

There are some obvious legacy issues around, though, which remind me of the weird duality of Windows 8 and 10's Control Panel/Settings screens. If you want to do anything with your resolution in Radeon Settings (now, thankfully, including custom GPU resolutions), you get spat out of the slick new UI and back into the old Catalyst-style interface. It's jarring, making it almost feel as though Radeon Settings is just a Qt port of CCC with a new wrapper over the top.

Similarly, the Raptr optimizing software isn't about to go away. But once that license ends, I doubt it'll stick around, given Radeon Settings includes its own version, with Frame Rate Control and per-game Overdrive overclocking.

Still, behind the new interface lies the foundation of a brighter, more-accessible software future. Crimson's a great start and I'm looking forward to the Captain Scarlet release next fall.

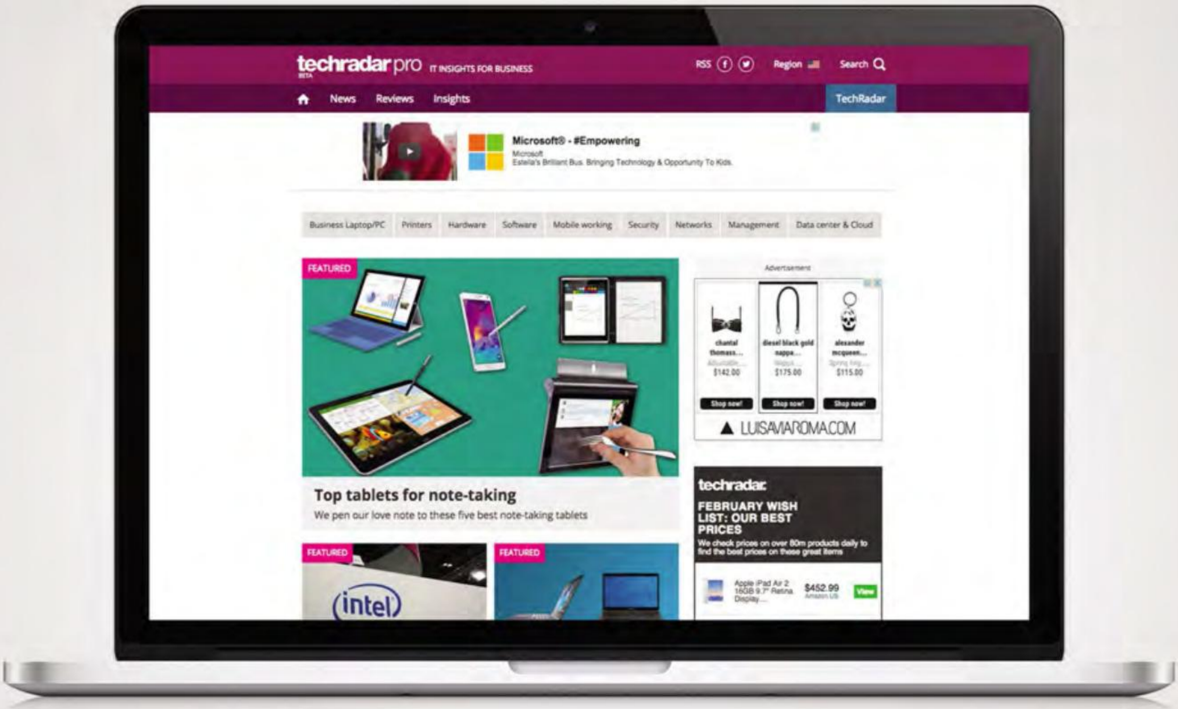
> AMD doesn't just want hardcore techies digging around the software; it wants everyone to get in on the fun.

Dave James has been building and writing about PCs and their constituent components for the last two decades.

Future

techradar.pro

IT INSIGHTS FOR BUSINESS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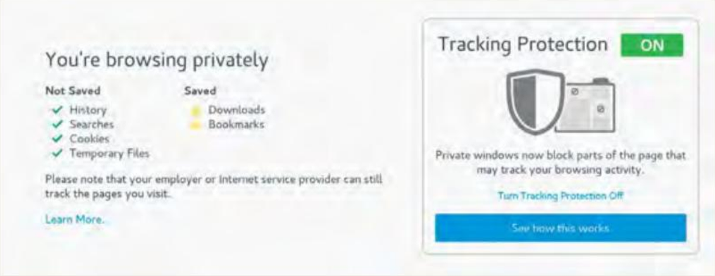
Alex Campbell

OPEN SOURCE

Why Private Browsing Is Harder than You Think

WHEN YOU OPEN YOUR BROWSER, there's generally no way of knowing what website is tracking you. Every click, page load, and even cursor heat map can be tracked. For many, this is disturbing, and rightly so.



You're browsing privately

Not Saved
- ✓ History
- ✓ Searches
- ✓ Cookies
- ✓ Temporary Files

Saved
- ● Downloads
- ● Bookmarks

Please note that your employer or Internet service provider can still track the pages you visit.

Tracking Protection ON

Private windows now block parts of the page that may track your browsing activity.

Firefox's new Tracking Protection is welcome, but it's not absolute.

Normally, this sort of technology is used to sell you stuff. However, depending on your location and what you're browsing, it can attract unwanted attention from law enforcement, your employer, or your ISP.

Chrome and Firefox have "private" modes—called Incognito and Private Browsing, respectively—that attempt to keep the majority of the tracking at bay. Sort of. These modes generally just wipe your cookies and history when you close the browser.

You can try this on your own. Just visit a website with private browsing on. If all works as planned, you shouldn't see ads that have been personalized to your shopping habits. Now, in another tab, try searching for baby diapers at Amazon (without signing in). If you reload that first tab, there's a good chance you'll see ads for products aimed at parents with young children. Behold: cookie magic.

While using private browsing can help a lot, there are hidden metrics that can still track you. Google collects a variety of metrics—such as location from your IP or GPS, and your operating system—even if you've got private browsing enabled and aren't logged in. Mozilla's new release of Firefox's Tracking Protection feature attempts to mitigate this, but its protection can't save you from everything.

What can you do? There are several options if you want to keep your digital footprint to a minimum.

Tor is known for enabling users to stay pretty anonymous online. However, Tor's privacy isn't absolute or infallible. If someone wanted to analyze your traffic on Tor, they'd need to operate an exit node. Being careless about other security practices can nix your effort, too. (The FBI did get the people behind the Silk Road, after all.) As long as you're not trafficking drugs or trying to plot terrorist attacks, you won't be attracting the full capability of law enforcement.

> "Google collects a variety of metrics even if you have private browsing enabled and aren't logged in.

Another trick to keep your traffic private is to use a virtual private network (VPN). A VPN can be handy to hide torrent traffic from ISPs, and will change your public IP address to that of the VPN server you're connected to. I also highly recommend using a VPN when using public Wi-Fi in airports, coffee shops, and college campuses. VPN tunnels encrypt your traffic between your PC and the VPN server, which can be a hedge against unencrypted wireless traffic. It also keeps anyone on the local LAN from snooping on your traffic. If you happen to be in a country with oppressive Internet control laws, a VPN can offer a way around firewalls and government packet snooping.

If you're looking to pay for a VPN provider, be sure to check its privacy policy, and look for a service that doesn't keep logs. After all, if law enforcement can request that the company turns over its logs, the VPN doesn't offer protection against government snooping.

VPNs have other handy uses, too. If you travel, a home VPN can give you access to all the resources on your home network. Many businesses (such as *Maximum PC)* offer VPN access to employees. But remember: If you use an employer's VPN, your traffic can be monitored as easily as if you were working at your desk in the office.

None of these things are foolproof or bulletproof. Think long and hard about using these tools, and when it's appropriate to use them. Whether we like it or not, nothing arouses suspicion more than the attempt to keep something secret.

Alex Campbell is a Linux geek who enjoys learning about computer security.

THE LIST

7 GREAT PC GAME CONTROLLERS

7 DUALSHOCK 4

If you want to use Sony's official PS4 controller on your PC, it is possible—with a little finagling.

6 LOGITECH F710

An affordable wireless option for those who prefer a PlayStation-style controller.

5 SCUF GAMING CONTROLLER

Before the Xbox Elite, this was the go-to controller for professional gamers, with its four back paddle buttons.

4 XBOX ELITE CONTROLLER

Quite customizable in its own right, the Xbox Elite Controller is best in class. It's also super-expensive at $150.

3 XBOX ONE CONTROLLER

Besides stiff bumper buttons, this is like its 360 equivalent, but a little more premium.

2 XBOX 360 CONTROLLER

Coming in wired and wireless variants, this has been the Old Faithful of controllers for PC gamers for years.

1 STEAM CONTROLLER

Valve's controller is the wildest of the bunch, pushing customizability, backward compatibility, and precision accuracy.

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TALKING

BY **ZAK STOREY**

Acer Shows Off Its Newest Gaming Monitors

We talk to Acer's Nick Walter about the company's latest gaming monitors, and the 100-inch gaming projectors coming to market early in 2016

There's an unwritten rule when it comes to PC gaming: Your system is only as good as your monitor. You could have two Nvidia GTX 980 Tis and an Intel Core i7-5960X, but if you're still running a 24-inch 60Hz 1080p panel, you may as well not bother. We spoke to Acer's business manager of displays about his thoughts on the monitor market, what innovations Acer is bringing to the table, and the rumors of a new line of gaming projectors.

We sat down with Nick to discuss Acer's upcoming displays.

Maximum PC: Can you tell us a little bit about what hardware you have on display here today?

Nick Walter: Well, we've got every Predator gaming product here today, so we've got our notebooks, our desktop range, our tablets, and our displays as well.

MPC: What displays are you going to be bringing out over the next few months?

NW: We have all of our Predator range, so our X34, which is our new curved G-Sync model. We've got the XP27, which was the first IPS gaming model in the market with Nvidia G-Sync—that's here. We've also got the XP28HK, which is a 4K panel—Predator gaming again—with Nvidia G-Sync technology enabled as well. So in terms of your high-end gaming, we've got our best of the best here today.

MPC: What's the range like exactly? Can you give us a little more detail about what's available for both premium and entry-level buyers?

NW: At Acer we've got, I suppose, the best of an entry proposition, all the way up to high-end gaming, up to the X34 curved G-Sync monitor. For that you are talking around $1,299. If you're looking at the entry point, that's about $299 for a 144Hz 1ms product, which is the GN246HL, so we've got every base covered in my opinion. In terms of entry point, right the way up to high-end premium.

MPC: We've been hearing a lot of rumors about Acer possibly bringing out some gaming projectors—can you tell us a little about them?

NW: Sure—we've got a gaming projector coming to the market in Q1, Predator branding again. It's full 100 percent sRGB color reproduction—you're

As bold as it is beautiful, witness the full majesty of Acer's curved 34-inch G-Sync display.

talking about the best color performance that you can get for a gaming projector, which we can give you up to about a 100-inch screen now. Can you imagine? Gaming on a product like that is going to be really, really cool. There'll be the fundamental sort of options within that projector, you know, gaming mode options as well, so there's a lot happening in that space. We'll be releasing more details and the spec closer to the time.

MPC: A lot of the older generations of projectors used to have problems when it came to being stuck on a static image for too long, staining the bulb. What is Acer doing to tackle this sort of problem?

NW: In terms of the technology that we use, we use DLP technology. So in terms of what you're talking about there, you're talking about color saturation. Now DLP technology is, I would say, the best technology out there in the marketplace. Over 90 percent of worldwide cinemas use that same DLP technology, so if you're going to your local cinema screen, they're likely using DLP technology. That screen, that bulb, is there for some time—I mean, you're talking about three to five years before you'd even have to replace the bulb. We also have unlimited lamp hours warranty on all our bulbs, so it's another feature that puts that to rest, let's say.

Fancy grabbing a cheap, entry-level 144Hz 1080p monitor?

MPC: So, what do you think is the most standout product from Acer here today for you personally?

NW: I would say our X34, so the Predator X34. I'm being selfish from my perspective, as I look after the displays category at Acer. But in terms of the stand-out product now, that really is, I think, the best product that we've brought to market. The XP27 has had a fantastic write-up and great performance reviews, but the X34 has just come into the market, and in my opinion, it is a true gaming screen that puts you in an immersive sort of environment. So if you're at home gaming with the X34, it's the best experience, and it'll give you the best gaming experience. So from my side, I think that's the very best thing we've got here today.

MPC: And what about virtual reality? Do you see that as a possible threat going forward for gaming monitors?

NW: Not at the moment, certainly not until the software develops and the technology becomes more stable. And even then, we're going to start seeing bigger and greater things coming to the display world—this is just the start of what Acer is bringing to market. We have the Z35 coming soon, which is the next major product launching. It's a 35-inch screen, Predator branding again, all the key gaming features that you want, using Nvidia G-Sync, and you can overclock the refresh rate up to 200Hz. So in answer to your question, is VR going to be a threat? Absolutely not in terms of what we're bringing to market now. If you're a gaming enthusiast, and want the best refresh rate and color, and you want an immersive gaming experience, display technology is where it's at.

MPC: The Z35 you mentioned earlier—is that going to be a TN or an IPS panel?

NW: That's going to be a TN panel.

MPC: Is there anything else you'd like to say to our readers?

NW: I'd just like to say from Acer, and from the whole Predator team, across all the categories now, Acer has really invested heavily in terms of research into the gaming world. The guys that are producing this at head office, they are gamers, so they're putting the technology into the machines that they want. And that's now covering every aspect of our range in the Predator lineup, from the tablets, to our notebooks, to our monitors that we're bringing to market now. These are specs that the gaming world wants, and that Acer and Predator are now delivering. And so for us, it's a really exciting time, and we're sure that consumers will be very, very happy and pleased with the products we're bringing to market now.

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

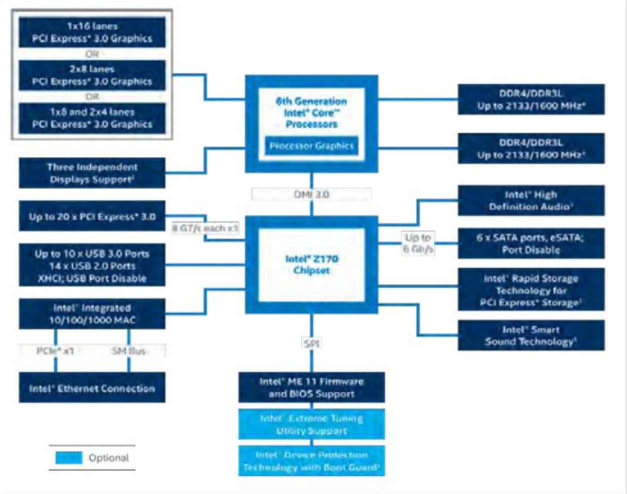
> Obsolete NAS
> Priceless PC
> Graphics Choices

Getting Old

Greetings from Connecticut! First: awesome job with the magazine. You strike the right balance between reviews, news, and hands-on stuff.

I own a Seagate NAS 220, and received an email telling me that there's an impending certificate upgrade, which will result in me losing remote access to the unit. I don't understand—I bought the NAS 220 specifically for this feature. It's out of warranty now (it's about five years old), so I expect the cold shoulder from Seagate.

Besides buying a different NAS, going through the cloud (Dropbox, Google, and so on), or enabling FTP on my 220, what can I do to remotely access files on my NAS? **–Liviu Oncioiu**


1x16 lanes PCI Express® 3.0 Graphics
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Three Independent Displays Support
Up to 20 x PCI Express® 3.0
8 GT/s each x1
Up to 10 x USB 3.0 Ports 14 x USB 2.0 Ports XHCI; USB Port Disable
Intel® Integrated 10/100/1000 MAC
PCIe® x1
SM Bus
Intel® Ethernet Connection
6th Generation Intel® Core™ Processors
Processor Graphics
DMI 3.0
Intel® Z170 Chipset
SPI
Intel® ME 11 Firmware and BIOS Support
Intel® Extreme Tuning Utility Support
Intel® Device Protection Technology with Boot Guard
DDR4/DDR3L Up to 2133/1600 MHz
DDR4/DDR3L Up to 2133/1600 MHz
Intel® High Definition Audio
Up to 6 Gb/s
6 x SATA ports, eSATA; Port Disable
Intel® Rapid Storage Technology for PCI Express® Storage
Intel® Smart Sound Technology
Optional

More PCI Express connectivity makes the Z170 chipset a significant upgrade over previous generations of Intel core logic.

THE DOCTOR RESPONDS: It sounds like your best bet for remote access is enabling FTP and taking advantage of the NAS 220's support for Dynamic DNS, which would let you get to the server through an easy-to-remember domain name.

Curious as to why Seagate's Global Access feature no longer works on your NAS 220, though, the Doc approached a company representative for more detail. The response reads as follows: "The BlackArmor family of storage solutions was originally introduced in 2009. While we strive to support our products for the entirety of their useful lives, it is an unfortunate inevitability that some technology updates will outpace the hardware on which they are being deployed—especially for older devices.

"In this case, the Seagate Global Access Service, powered by TappIn, underwent a major update on October 7th that can no longer be supported by the code base on our older BlackArmor NAS storage devices. Subsequently, some BlackArmor customers will not be able to use the remote access feature.

"We regret any interruption in service for our users and have reached out to those with products still under warranty to advise on how they can deal with the change in service."

The Cost of Security

Hey Doctor, I recently upgraded to an Asus H97-Plus and, while installing hardware on to it, I noticed this curious little slot for something called a TPM. It was empty, of course. But after reading through the manual, it sounded like something I should have—a Trusted Platform Module with some serious security features. I bought a TPM and installed it, along with the accompanying software. The encrypted drive space is nice.

My PC is used mostly for gaming. Will this TPM and its services end up hurting me in terms of speed? I don't have the fastest processor out there (it's a Core i5-4690K), and my graphics card is a GeForce GTX 750 Ti. I haven't noticed much of a performance difference with the module on or off, but I struggle with playable frame rates in newer games, specifically *GTA V*. Should I use this TPM or am I better off without it? **–Ryan Anthony**

THE DOCTOR RESPONDS: Enabling full-disk encryption through BitLocker, which is something you can do after installing your TPM, does add processing overhead. However, if your storage device includes support for hardware-based FDE, that's offloaded. For all intents and purposes, the TPM isn't going to make a difference.

What's really holding your gaming performance back is that GeForce GTX 750 Ti. While the Maxwell-based card is incredibly efficient, it's also

↘ submit your questions to: doctor@maximumpc.com decidedly mid-range. A better complement to a Core i5-4690K (still a tremendous CPU) would be a GeForce GTX 970 or 980.

Money No Object

Bob Elman asked the Doctor in November, "How about a state-of-the-art system build with video rendering, photography, and business in mind?" Like Bob, I desire a machine capable of serious processing power and exceptional GPU performance. I compiled a foundation and would like your feedback in the context of Bob's question. I use Rhino with Grasshopper and Unity3D to create VR walkthroughs for architecture. Here are the specs, at a tad over $9,000 on Newegg: 1x Asus Z10PE-D8 WS server motherboard, 2x Intel Xeon E5-2660 v3 (2.6GHz), 2x Corsair Hydro Series H105, 1x Corsair Dominator Platinum 128GB (8x 16GB) DDR4-2400 memory kit, 2x EVGA GeForce GTX Titan X, 1x Intel 750 Series 400GB PCIe SSD, 1x EVGA 120-G2-1600-X1 80 PLUS Gold 1,600W PSU, and Microsoft Windows 10 Professional.

For those who are not sure, does the rendering happen on the CPU? My build has two 10-core CPUs for computing light- and vector-related stuff. The GeForce GTX Titan X cards are to ensure frames rates above 60 in Oculus DK2. Help Doc.

–Morgan Garrard

THE DOCTOR RESPONDS: Given unlimited funds, there's very little reason to be strategic about hardware choices, Morgan. Value flies out the window and every single-digit performance gain adds four figures to the price tag. With that said, your configuration is an absolute beast.

You'll have to excuse the Doctor's limited experience with Rhino 5 and Grasshopper. Both applications appear to be single-threaded (for modeling), while your rendering plugins would be the ones able to leverage multiple cores.

Those GeForce GTX Titan X cards are great for gaming, although McNeel seems to suggest Nvidia's professional-class Quadro cards might be a better choice for their OpenGL-optimized driver. Additionally, depending on your plugins, rendering could be accelerated more effectively through CUDA, rather than the Xeons.

The good news is that Grasshopper's David Rutten says he's working on Grasshopper 2, which is expected to incorporate more threading in the places it makes sense. That would make better use of those 10-core CPUs. And if we're throwing around big bucks here, a couple of Xeon E5-2687W v3s would contribute 500MHz of base clock rate over the E5-2660.

Stomp Out Bottlenecks

I'm excited about the prospect of finally upgrading my PC from its aged X58 and Core i7-920. Now that reviews are coming in for the new Z170-based platforms, I'm hoping to choose my direction by the end of the year. My rig is primarily for gaming. Currently, I have two GeForce GTX 780s, which treat me well.

It's my understanding that the Core i7-6700K is limited to 16 lanes of PCIe 3.0. How would that impact my 780s in SLI if they are only running in x8 mode? Would this cause a bottleneck? If not now, could it become an issue with future cards? On the same point, do I lose the ability to run an M.2-based SSD if I use two GPUs, as that needs four PCIe lanes?

I was also reading about the PLX chip, and while it sounds good in theory, wouldn't the data still need to traverse back to the CPU over 16 PCIe lanes? EVGA and Gigabyte have boards with that switch, but I'm not convinced it's worth the extra money, since everything is ultimately limited by the CPU's controller. In fact, wouldn't it just add latency? Is the only advantage that you can run three- or four-way SLI? Any clarification you could provide would be awesome.

–David Pinto

Armed with a GM206 GPU, the GTX 950 is perfect for HDMI 2.0.

THE DOCTOR RESPONDS: There are a lot of questions there, David. From the top, yes, Intel's Core i7-6700K has a 16-lane PCIe controller. But splitting that connectivity between two high-end graphics cards won't affect performance in any meaningful way. Each link still provides almost 8GB/s of throughput, which exceeds the traffic needed by a graphics processor. That should hold true moving forward, though who knows what AMD and Nvidia have in store?

Let's say you want to add a PCIe-based SSD. This is where Z170 truly shines. The Platform Controller Hub offers up to 20 of its own PCIe 3.0 lanes, and it connects to the host processor through an interface called DMI 3.0 that's able to keep up. The Doc has MSI's Z170A Gaming M7 on the bench right behind him. It'll let you do SLI across two x8 links, and it exposes two M.2 slots attached to the PCH.

Avago is now the company behind those switches you mentioned. The popular PEX 8747 takes the CPU's 16 lanes and turns them into a x16/x16, x16/x8/x8, or x8/x8/x8/x8 configuration using five ports. Latency is down in the ~120ns range, so don't worry about it affecting your gaming experience. For a dual-GPU gaming PC, though, they're just not necessary.

Video Playback

I'm working on a PC for a friend. It'll be a combination 24/7 file server and Kodi streaming box, which he'll connect to a 4K TV for display output. If I'm building something to last, I want it to be completely modern and take advantage of the hardware he owns.

The TV supports HDMI 2.0, so it is capable of 4K at 60Hz. The lowest-end graphics card I can find with a matching interface is Nvidia's GeForce GTX 950. My gut tells me that it should have no problem playing back video at the same resolution and refresh rate, but I would like confirmation before telling my friend to buy it. My online searches turned up people asking similar questions. However, the responses they received were that the 950 can't game at 4K. This machine will never be used for gaming; it just needs to stream video.

I am not really set on specs for the rest of the system, but as a general guide, it will be a Core i5 with 8 to 16GB of RAM, a 256 or 512GB SSD for the OS and apps, and four 2TB disks in RAID 10 for media files.

–Tim Plett

THE DOCTOR RESPONDS: Just to clarify, you're talking about local playback from a PC out to a television through HDMI 2.0, right? Streaming—whereby content is presented as it's being delivered—suggests that there's a network in between, adding complexity to the equation (particularly when you're talking about 4K content at 60 frames per second).

If so, then yes, a GeForce GTX 950 would suit your purpose nicely. Its GM206 actually boasts more advanced decoding hardware than Nvidia's flagship GM200 GPU, adding full acceleration for HEVC/H.265. This relatively new compression standard can be used to improve video quality at a given bit rate, or cram an existing quality level into smaller files. It's a lot more processing-intensive, though, so by offloading the task to the graphics card, your Core i5 won't have to work as hard (or use as much power).

You're right, the 950 is the cheapest discrete card with HDMI 2.0 support. If only there was more 4K content....

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GEFORCE GTX
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GTX

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MAXIMUM PC KICK ASS!
PC GAMER EDITOR'S CHOICE ★★★★★

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FLAT-PANEL PERFECTION

With more features and technology than ever, welcome to the golden age of PC monitors! *By Jeremy Laird*

A FEW YEARS AGO, the market for monitors was as exciting as binge-watching filibuster reruns on C-SPAN. Maybe not quite that bad, but your choices basically boiled down to a couple of resolutions across a few screen sizes. There was the TN versus IPS thing when it came to panel technology, too, with VA thrown in as a wild card. And the introduction of LED backlights shook things up a bit. But the fires of innovation were hardly burning bright.

Fast-forward to today, and you've got the opposite problem. There's so much choice, it's hard to know where to start. Size-wise, you can go all the way to 40 inches without even spending all that much cash. Resolutions up to full 4K are now affordable, too. And you can now snag something with a super-wide aspect ratio. Oh, and don't forget to decide if you want a flat or curved panel. You also need to decide whether high refresh rates of 120Hz and more are your bag. And do you want that with or without Nvidia's G-Sync adaptive sync technology? Or AMD's alternative? You might want to bear in mind flicker-free backlight technology, too.

Meanwhile, if we still seem to be stuck with the same choice of core LCD panel technologies as before—with TN, IPS, and VA—recent developments have blurred the boundaries. TN technology is not the image-quality dud it used to be.

And as if all that isn't enough, the near future will bring further complications. How about more vibrant colors, and the best ever contrast from an LCD monitor, thanks to quantum dot technology? However you slice it, there's much, much more to keep up with than before. But that's just dandy, because this month we've gathered together no fewer than 12 screens that capture the very best panel tech you can currently buy.

WITH SO MANY different screen types, sizes, and technologies on offer, it's difficult to know where to begin. So let's start with something familiar. Do you want a TN, IPS, or VA LCD panel in your monitor?

Much will come down to your preferred usage. TN remains the fastest and most responsive technology, so that's great for games. IPS is still the best for color accuracy, both in static terms and in terms of maintaining accuracy from different viewing angles. That makes IPS great for serious applications, such as image-editing, and also for general Windows work. VA, meanwhile, has a pretty good line in contrast and color vibrancy. An obvious pick for watching lots of video and movies, then.

Where things get more complicated involves the increasing convergence of panel quality, regardless of type. As each panel type improves, they all inevitably converge on the same high-quality image production. True perfection hasn't been achieved, of course. And in many ways, LCD panels powered by backlights are fundamentally flawed compared to likely future display technologies, which produce light on a per-pixel basis. But as an example, some of the very latest TN panels have far better colors and contrast than before, and in those regards now rival cheaper IPS panels, at the same time as maintaining their speed and response advantage.

Meanwhile, some of the other technologies we're discussing don't always play nicely with every panel type. If you want high refresh in an IPS panel, for instance, you limit your choice to a tiny handful of panels. If you want high refresh, IPS, and 4K, you're out of luck. You can't currently buy a PC monitor that combines all three. So that's an important early lesson. As things currently stand, you can't necessarily cherry-pick your favorite features and expect there to be a monitor that delivers them all. Some combinations simply don't exist.

THE NUMBERS GAME

Next, let's talk native resolution. Specifically, the question of whether more pixels are always better. The 3,840 by 2,160 pixel grid of the latest 4K monitors certainly gives you more working space for apps, and more detail in games. But there are catches.

For starters, even Windows 10's interface doesn't scale flawlessly if you change the DPI setting away from 100 percent. That means smaller screens with very high resolutions can be problematic. The current crop of cheap 28-inch 4K monitors are as small as we think most people should go; 32-inch and up works better because it means you can use the screen comfortably without scaling. For gamers, 4K is a problem, too, because it makes for one heck of a load on your graphics card. Later in 2016, we're expecting new GPUs that can handle 4K gaming with relative ease. For now, it's a potential stumbling point, especially if your graphics card has a year or two under its belt.

A similar problem applies to very high refresh monitors, especially those that also offer high resolutions. Driving a 2560x1440 at 60fps at very high detail is hardly a gimme, but if you want to make

Nvidia's G-Sync is currently the pick of the adaptive sync options.

> As each panel type improves, they all inevitably converge on the same high-quality image production.

Below: Say "Hello" to 34 inches of curved LCD hotness, courtesy of Acer.

Right: Philips' 4K 40-inch übertron is surprisingly affordable.

PREDATOR
PHILIPS

the most of a 144Hz panel, you'll need over double that frame rate from your graphics card. Ouch!

On the other hand, once you've experienced the slick smoothness of a high-refresh monitor, you may be hooked. Moreover, if you're not a big gamer, the load on your GPU is less of an issue. And yet your choice is still limited. Want a 40-inch 4K monitor with at least 120Hz support? You're out of luck.

GOING WIDE

Next up is the new crop of superwide screens with 21:9 aspect ratios. The latest take on this format is a group of 34-inch monitors with 3,440 by 1,440 pixels. For games and 21:9 aspect movies, these are spectacular. In many ways, they're the gamer's choice right now. Except you can't have them with high refresh, nor with the fastest panel tech. Tricky.

For everything apart from games, that 21:9 aspect is a problem. With standard 16:9 aspect HDTV content, you're left with big black bars on either side of the screen. And on the Windows desktop, similar money will buy you a 40-inch 4K screen with far, far more real estate, especially when it comes to vertical resolution. It's a similar situation with curved 21:9 monitors. Awesome for games, suspect as general-purpose panels.

Another technology that you can rule in or out based on the whole gamer or not-gamer thing is adaptive sync. For gamers, the ability to synchronize the fluctuating frame rate of your graphics card, in-game, with the refresh of your monitor is a really big deal.

If you are a gamer, you'll need to choose between Nvidia's G-Sync and AMD's FreeSync technology, of course. But, for now, that's not much of a choice. G-Sync is a finished and polished product. FreeSync is much more a work in progress. Nvidia wins that one hands down right now.

If those are the key tech options, you then have to mix and match them according to your preferences. Do you want 4K TN at an affordable 28 inches? Or how about 21:9 aspect, 34-inch, a curved screen, and adaptive syncing? Of course, that may be a bit rich, and you don't play games, so an affordable 27-inch, with a nice 2560x1440 IPS panel might be your bag. Then again, maybe you're a purist gamer who demands ultra-fast responses and high refresh rates. Or you might be on a really tight budget, so a modest 22-inch 1080p is nearer your price point.

It's confusing stuff, but the good news is that we've rounded up a dozen prime panels that together tick all of those boxes and more. So while it's true that you can't quite have any combination of the latest technologies and features in a single screen, there's a very good chance there's something here that's awfully close to your perfect panel.

Right: Even with Nvidia's mighty GeForce 980Ti, driving 4K displays is a big ask.

Below: Asus's upcoming RoG PG34Q promises to be a gamer's delight.

QUANTUM LEAP

The last few years have seen innovation on an awesome scale. So, are we done, or can you expect more of the same in 2016? One thing is for sure: More pixels are likely to be on the 2016 menu. A few 5K screens have already popped up. Could 8K be the big thing in 2016? Maybe. LG and other makers of LCD panels are currently tooling up for 8K—that means 7,680 by 4,320 pixels, or no fewer than a grand total of 33,177,600 dots. Or if you count each RGB sub-pixel, we're talking 99,532,800 colored dots being refreshed at least 60 times a second.

More likely to see wider mainstream adoption is quantum dot technology. Already popular in the HDTV market, it's not revolutionary—it's about making LCD panels even better. In fact, you don't even need a new LCD panel for quantum dot to do its stuff. Just a new backlight. So, what is it?

If you didn't major in physics, this could be tricky, because here we enter the realm of nanomaterials. In this case, it's a material that absorbs certain frequencies of light, converts it, and re-emits. The "quantum" bit is because the semiconductor crystal material leverages a nanoscale effect known as quantum confinement, which involves electron holes, the exciton Bohr radius, and two-dimensional potential wells. You knew that, right?

The point is that these dots are highly tunable. So you can take something like a cheap, dirty LED backlight, and use this material to clean up the light. So you can use quantum dot tech to modify and greatly improve the quality of a cheap, single-color LED backlight, and make it as good as or better than an expensive RGB backlight. That means more accurate and vivid colors without the big bills.

Philips was first out of the box with a quantum dot PC display in 2015. The technology really works and makes screens visibly more vivid. We're expecting a significant roll-out of QD in 2016.

Acer XR341CK

This ain't no flatscreen…

ARE YOU A PC GAMER on the hunt for a high-end monitor? Then we feel your pain. Picking a panel is now a proper palaver. For proof, look no further than the Acer XR341CK.

Let's start by counting the ways this monitor delivers gaming greatness. It all begins with that football field-sized LCD panel. Not only is it 34 inches across and superwide, thanks to a 21:9 aspect ratio, it's also curved, it rocks 3,440 by 1,400 pixels, and it's IPS to boot. Nice.

As if that wasn't enough, Acer has thrown in adaptive sync, and notched the refresh up to 75Hz from the 60Hz norm. For the record, the adaptive sync is courtesy of AMD's FreeSync rather than Nvidia's G-Sync. Keeping up?

If that's the XR341CK's impressive-but-not-quite-comprehensive set of on-paper credentials, any real-world quibbles evaporate pretty quickly once you fire her up and load your favorite games. This thing is glorious. It's subjective, but the combination of exaggerated width with the subtle wrap-around effect of the curved panel is genuinely special. The curve really does add a little something over 34-inch superwide screens that are otherwise very similar, but use conventional flat panels.

The sheer quality of the IPS panel is a highlight, too. It might just be the most pleasing and vibrant screen of the lot, and achieves that without crossing the line into over-saturated and cartoonish colors. It's nicely calibrated by default, too. If that's the good news, the gaming downsides start with FreeSync, which simply doesn't work as well as the G-Sync alternative.

The fact that it doesn't support those slick 120Hz-plus refresh rates is a downer, too. As for non-gamers out there, you can probably jog on. The superwide aspect and curved panel are at best of dubious benefit, and can actually be awkward when viewing conventional Windows apps. So, there's better value to be had elsewhere.

VERDICT
8

Acer XR341CK

⊞ **CURVACEOUS** A gaming great.

⊟ **NOT BODACIOUS** Not a true all-rounder.

$869, http://us.acer.com

AOC G2260VWQ6

TN? It's not so terrible

ONCE UPON A TIME, in a land far, far away, TN monitors sucked. Actually, that land was pretty much all of planet Earth, and the time was until very recently. Then the first cheap 4K monitors with TN panels rocked up, and proved the technology could at last be capable of properly pleasing colors to rival the likes of IPS and VA panel technology.

What we hadn't seen, previously, not even in Asus's big-ticket, 27-inch ROG Swift PG278Q, was a TN screen that was good in anything but a 4K form factor. Until now. Because the new AOC 2260VWQ6 is vibrant and punchy in a way we've not seen before in such an affordable screen.

In fact, the 2260VWQ6 is so much better than you expect from a budget 22-inch 1080p monitor that it has you wondering whether somebody borked the specification list, or maybe the wrong panel went in at the factory. At a glance, it might even look better than the Philips 22-inch monitor and its 6-bit IPS panel.

Then you take a closer look at the viewing angles, and realize that this can only be a TN screen. But it says something that the illusion lasts as long as it does. Further inspection reveals additional image quality flaws, including some noticeable compression in brighter colors. But overwhelmingly, the subjective impact is positive.

It also sports some impressive features for this price point. You get a flicker-free backlight, with reduced blue tones to minimize eye strain, a slight refresh rate bump to 75Hz, and support for AMD's FreeSync technology. The latter requires DisplayPort connectivity, which again isn't something you'd normally expect at this end of the market. On the other hand, FreeSync also doesn't work well enough on any current monitor to contribute much to gaming fun.

OK, with the tilt-only stand and the panel's puny 22-inch proportions, this is a modest monitor by any metric. But it's also far, far better than we were expecting.

VERDICT
7

AOC G2260VWQ6

⊞ **TN-TASTIC** The best 22-inch TN screen yet.

⊟ **TN-RRIBLE** It's still just a 22-inch TN screen.

$204, http://us.aoc.com

AOC I2276VWM

IPS for those in poverty

WONDERING WHY we're packing two ostensibly very similar 22-inch panels from the same brand this month? It's because, together, the AOC G2260VWQ6 and I2276VWM deliver an object lesson in value and LCD panel technology.

The AOC I2276VWM is typically available for a few bucks less than its AOC G2260VWQ6 sibling. For the most part, there's not much to choose between them. In both cases, the native resolution is 1080p full HD. Both offer stands with tilt-only. These are not premium panels.

The G2260VWQ6 has a few interesting features if you're a gamer on a budget. But arguably its most interesting selling point is a technology that isn't truly ready for public consumption—AMD FreeSync. However, the I2276VWM has a trump card: It's based on IPS panel technology.

That should guarantee superior colors, viewing angles, contrast, the whole package. So, the choice must be a no brainer. Less money for better image quality, right? Except it's not that simple.

The AOC 2260VWQ6 is possibly the best 22-inch TN panel around. In fact, it's so much better than we're used to that it suddenly becomes a very even contest between that and the low-spec IPS panel in this AOC I2276VWM model. For colors and contrast, there's little in it, and the edge in terms of color vibrancy might even go to the TN panel.

The AOC I2276VWM retains traditional IPS honors for viewing angles, of course, but can't quite compete for pixel response. The choice therefore comes down to that of usage model. While before we'd have only recommended TN in this kind of contest for the hardest of hardcore gamers, it's different now. The AOC I2276VWM still has a certain appeal as a very affordable IPS PC monitor. And in our testing, it revealed no major image quality flaws. But this little fraternal fisticuffs proves that the gaps between the various LCD panel technologies are narrowing rapidly.

VERDICT
6

AOC I2276VWM

➕ **FOR RICHER** Uber-affordable for IPS.

➖ **FOR POORER** IPS, but not as you know it.

$129, http://us.aoc.com

AOC U3477PQU

A bit behind the curve

BOTH THE ACER XR341CK and this are spectacular 34-inch screens with immense 3,440 by 1,440 pixel grids. Both offer IPS panel technology for the best possible colors. But the Acer is dramatically more expensive, and that's primarily because it's curved. So do you feel significantly second-best sitting in front of this conventionally flat-paneled AOC screen?

In isolation, it's a stunner. Thirty-four inches is big by any measure, but combined with the superwide 21:9 aspect ratio, it's even more dramatic. When it comes to games and video playback, that aspect ratio also makes for a very pleasing fit with human binocular vision. It just works, filling your field of vision.

Problem is, a screen this big and this wide feels as though it's getting away from you a bit at the extremities. With a little curve, you feel that bit more embraced, that bit more immersed.

Of course, unlike the Acer, this screen won't go beyond 60Hz refresh, and there's no frame syncing technology for smoothing out those in-game microstutters. Then there's the basic image quality. It's simply not as good as the Acer.

The default calibration has the color temperature set to "warm" as opposed to "normal," for instance. That's an easy fix, despite the characteristically lumpy AOC on-screen option menu. But even then, the panel's whites aren't quite as clean and bright as the Acer's, the colors not quite as vibrant, punchy, and pleasing.

We also can't help noticing a little compression in both black and white tones in our test images, though props to AOC for achieving a perfectly smooth gradient. Make no mistake, this is still a lovely screen, and an interesting value proposition. You just need to be aware that the lower price means that some compromises have been made when it comes to some aspects of the image quality.

VERDICT
7

AOC U3477PQU

➕ **HIGHLINE** Flat is still fabulous.

➖ **FLATLINE** Curved is more immersive.

$599, http://us.aoc.com

Asus ROG Swift PG278Q

The king is dead

SPARE A THOUGHT for the poor old Asus ROG Swift PG278Q. It was the daddy once. The screen gamers lusted after. The one to have. And not all that long ago, either.

It was only 18 or so months ago that the original ROG Swift rocked our world with a killer combination of features. First up was a generous 27-inch LCD panel with plenty of pixels: 2,560 by 1,440, to be precise. Then there was support for both Nvidia's G-Sync adaptive sync cleverness, plus 144Hz refresh technology.

Combined, that made for the ultimate in super-smooth gaming, assuming your graphics card had the power to pump enough pixels. The whole thing was wrapped up in a slick, premium chassis, and held aloft courtesy of a quality, fully adjustable stand. The want was very, very strong.

Fast-forward a year and a half, and the original Swift isn't looking quite so clever. Part of that is down to the fratricidal menace of the new ROG Swift PG279Q. That ticks nearly all the same boxes as the '278 but with one crucial upgrade. It switches this original Swift's TN panel for a snazzier, more colorful IPS item. Dang.

The upshot is something of an existential crisis for the PG278Q. If the new PG279Q does everything it can, plus improves on several areas of image quality, it's a done deal, right? Not quite. The core competence of these Swift panels is speed. And the fact remains that TN remains the fastest responding panel technology money can buy. For gamers who demand the least pixel blur, the PG278Q still has the edge in that department.

What's more, it's around $250 cheaper than its IPS sibling. Not bad. Still, the problem is that it's not cheap, especially given its TN panel is behind the curve when it comes to colors and contrast. It's certainly not as vibrant as the latest 4K TN monitors, for instance. Ultimately, it's a slightly tough sell in the fast-moving monitor market.

VERDICT
8

Asus ROG Swift PG278Q

⊞ **MONARCHY** An awesome gaming machine.

⊟ **TYRANNY** TN panel is unmistakable.

$549, www.asus.com

Asus ROG Swift PG279Q

Long live the king

IS THIS THE MESSIAH OF MONITORS? The one screen to rule them all? It certainly ticks a lot of boxes. More to the point, it ticks boxes for all kinds of PC enthusiast. Whether you're a gamer or a graphics pro, there's something to appreciate.

The gaming credentials include refresh rate capability up to a dizzying 165Hz, along with Nvidia's fabulous frame-syncing technology, G-Sync, which ensures this monitor and your graphics card are perfectly in tune. But what really broadens the appeal of the PG279Q is the combination of those features with a high-quality IPS panel—in this case, 27 inches across, and with a native 2560x1440 resolution.

You also get an excellent, fully adjustable stand, along with DisplayPort connectivity, and a few other frills. The upshot seems like a screen that delivers everywhere and compromises nowhere. In reality, it's an excellent screen, but somehow the whole is less than the sum of its parts.

Some of that is down to pricing. If you want to maximize your desktop real estate for Windows apps and productivity, the fact that Philips will do you a much larger 40-inch display, with full 4K capability, is hard to ignore. Similarly, there's no denying Acer's 34-inch curved monitor is both more spectacular and more immersive for games. And while the IPS panel is appealing for graphics professionals, if you want the color accuracy of IPS technology for serious image editing, there's no need to pay a premium for features such as Nvidia's G-Sync. What's more, in subjective terms, the Asus's image quality falls very slightly short of the best. The Acer XR341C, for one, is a more pleasing panel on the eye.

All of which makes this latest Swift from Asus difficult to place. It's a fantastic screen, the best all-rounder, and very much a candidate for top honors. But it also lacks a knock-out punch—that sense of the spectacular—that you might expect at this price point.

VERDICT
9

Asus ROG Swift PG279Q

⊞ **SUBLIME** One screen to do it all.

⊟ **RIDICULOUS** Boy, it will cost you.

$799, www.asus.com

BenQ GW2765

A simply fabulous screen

KEEP IT SIMPLE, STUPID. If the BenQ GW2765 is anything to go by, that brutal observation could be the best advice. Because what this monitor does well, it does very well indeed. The things it doesn't do you may not care about.

The headline specification involves a 27-inch diagonal and 2,560 by 1,440 pixels. There's no crazy-high refresh rate. You don't get frame syncing from either AMD's FreeSync or Nvidia's superior G-Sync technology. It's not curved or 4K, and nor does it look fancy in any way.

But what it does offer is IPS panel technology and a robust, fully adjustable stand. And that panel is a truly delightful thing. The colors are super vibrant and accurate, thanks to nicely executed out-of-the-box calibration. The black and white scales are faultless.

The anti-glare coating is nice and smooth, too, with none of the old-school twinkle that used to blight IPS panels. Speaking of traditional IPS downsides of yesteryear, you'll struggle to pick up any IPS glow in dark tones, either.

As a gaming panel, it's not half bad, either. There are four levels of pixel response available from the overdrive menu. You can switch overdrive off, or choose from one of three enabled settings. The middle setting jazzes up the response, without introducing inverse ghosting ugliness.

If you insist on some shortcomings, the backlight is very slightly yellow, and the integrated speakers are feeble, tinny, and pointless. But for the hardware that actually counts, like the stand, it's well made and robust, even if the overall look brings new meaning to the word "anonymous."

Think of the BenQ GW2765 as a purist among LCD panels. There are no gimmicks or pointless features. It's just a very nice, decently calibrated IPS monitor, with sufficient desktop real estate for serious productivity work, and fantastic image quality that allows it to turn its hand to almost task. All for a very reasonable price.

VERDICT
9
K!CK ASS!

BenQ GW2765

- **PURITY** Simply wonderful IPS image quality.
- **POVERTY** Look elsewhere for fancy features.

$349, www.benq.us

BenQ RL2755HM

It's big. But is it beautiful?

JUST OVER 200 BUCKS for a 27-inch PC monitor? Where do we sign up? But hang on. Before we get carried away with what seems like a killer value proposition, let's consider the specifics of what the BenQ RL2755HM has to offer.

The closer you look, the more obvious it is that there's not a huge amount on offer beyond sheer scale. The BenQ's panel is inevitably a TN item, and it delivers just 1,920 by 1,080 pixels. Right away, that's a problem. Stretched across a 27-inch display, those pixels look big and blocky.

That much you could guess from the basic specifications. What you have to see to fully appreciate is the disappointing overall image quality. This is a TN panel out of the old school. That means dull colors, poor contrast, and limited viewing angles. It doesn't exactly knock our test images dead, either. The white and black scales are actually OK, and betray relatively little evidence of compression. But the gradient rendering is a disaster, and shot through with very obvious banding. Yuck.

While we're twisting the knife, the wide range of special image quality modes in the on-screen menu doesn't add up to a hill of beans. There's not much you can do if the panel quality isn't truly there. Its tilt-only stand is another reminder that corners have been cut to hit a price point. As a PC monitor for apps or serious productivity, therefore, we recommend you run a mile. We won't be rushing to buy it as a cheap movie monitor, either.

However, as an affordable screen to play games, it makes a lot more sense. OK, it's not the punchiest, most vibrant panel you'll ever see. But the image quality isn't actually ugly, and it's certainly fleet of pixel and low on input lag. It also has several gaming-friendly features. The dual HDMI inputs enable you to hook up a PC and games console in parallel, for instance, and the flicker-free, low-blue backlight should make for less eye strain.

VERDICT
6

BenQ RL2755HM

- **BLACK FRIDAY** A lot of monitor for the money.
- **BLACK MONDAY** You get what you pay for.

$229, www.benq.us

BenQ XL2730Z

Taking aim at Asus

AT FIRST GLANCE, it looks as though this BenQ monitor exists to take the fight to Asus's Swift gaming monitors. It's a 27-inch display, with a 2,560 by 1,440 pixel grid. It's capable of über refresh rates up to 144Hz, and it supports adaptive-sync refresh to boot.

In this case, it's FreeSync, as opposed to the G-Sync featured by both the Asus Swifts reviewed here. But even so, that's just the usual AMD versus Nvidia deathmatch, right? Up to a point. The BenQ XL2730Z does line up awfully close to the Asus ROG Swift PG278Q. They both have what looks like the same TN LCD panels, with identical image quality. Put them side by side, as we did, and it's virtually impossible to separate them on factors such as colors, contrast, viewing angles, pixel response, and all that jazz.

Neither looks hugely vibrant, it has to be said, and you'll find evidence of compression in both the black and white scales, along with some banding in gradients, both of which betray the lack of color fidelity from TN panel technology.

But both screens are also ultra-responsive. And there's not much in it when it comes to the rest of the feature set. Either way, you get a high-quality stand and a premium feel. Where a gap begins to grow involves adaptive sync. Put simply, Nvidia's G-Sync tech is just better than FreeSync right now. If that matters to you, the $50 premium for the Asus screen looks like good value.

However, that's probably not the greatest challenge for the XL2730Z. In fact, that arguably comes from inside the BenQ camp, in the form of the GW2765. It's significantly cheaper but hammers the XL2730Z in most image quality metrics, thanks to its gorgeous IPS display. Yes, gamers will appreciate the XL2730Z's high refresh rate support, fast pixel response, and low lag. It's a great gaming monitor, no question. For everybody else, it looks pretty pricey for a screen that's not nearly as nice to look at.

VERDICT 8

BenQ XL2730Z

- **GAME WINNER** Slick, smooth, and super-fast.
- **GAME OVER** TN panel quality all too obvious.

$499, www.benq.us

Philips 227E

Cheap, but at what cost?

WE CAN PROBABLY THANK APPLE, albeit grudgingly, for bringing IPS screen technology into the consciousness of the masses. Like a lot of great technologies, Apple neither invented it nor refined it. But by sticking it in iPhones and iMacs, and rolling out the sales shtick, Apple did make IPS something a lot of people know about and want.

The net result of which is IPS screens in everything down to $450 fire-sale tablet computers. That's surely at least part of the reason why screens such as the Philips 227E6 exist at all. The big LCD panel makers have responded to widespread demand for cheap IPS screens. So, we get IPS monitors like this, at a price that previously wasn't possible.

Inevitably, there's a catch. When IPS gets this cheap, it's not quite the same IPS as you'll find elsewhere. The most obvious trade-off is color fidelity. Cheaper IPS screens make do with six bits of color data per channel, versus the eight bits minimum of more expensive screens. Do the math, and that comes to 262,144 colors for 6-bit, and 16.8 million for 8-bit. OK, 6-bit screens can use dithering to close the gap a bit, but there's no question you lose some of what makes IPS special when you reach down this far.

What you do not lose, as this Philips screen proves, is the big advantage IPS has over TN panel tech when it comes to viewing angles. Overall, it's a nice enough screen for the money. But the colors don't exactly pop, and the overall effect doesn't exactly scream "IPS." Factor in the tilt-only stand and cheap-feeling chassis, and you are in no doubt about what end of the market you are in.

But then you get what you pay for, and at this price point, we doubt you'll be disappointed. It's not a lot to pay for a 22-inch monitor with full-HD 1080p support, and decent all-round image quality. For those on a very tight budget, we're glad screens like this exist.

VERDICT 6

Philips 227E

- **VALUE OPTION** Low price for an IPS panel.
- **FALSE ECONOMY** 6-bit color fidelity.

$148, www.usa.philips.com

Philips BDM4065UC

4K and 40 inches FTW?

DO YOU WANT a multi-talented screen that's pretty good at a lot of things? Or would you prefer a panel that delivers on a narrower range of metrics, but absolutely, positively nails them?

If the latter sounds like your style, the Philips BDM4065UC is definitely for you. Because nothing else here comes close for a combination of sheer, cinematic scale, and immense desktop real estate. That's what a 4K native resolution writ large across a 40-inch LCD panel does. It's a spectacle no other screen can match.

Indeed, it's only at this huge scale that 4K really works. You can set the Windows DPI slider to 100 percent and everything just looks right. Meanwhile, you get so much space on the desktop, and so much detail in games, that every other monitor instantly looks second rate.

The problem is that this is also a fundamentally flawed monitor. For that we blame its HDTV origins. This is more a tweaked TV than a pure PC monitor. You can see that in the rudimentary stand that has no adjustment at all, not even tilt, and the cheap, hollow feel of the screen enclosure.

But where you'll really notice it is with the LCD panel itself. It's a VA panel, which is a popular technology for TVs, on account of its punchy colors and outstanding contrast. However, VA viewing angles aren't great compared to IPS. That's fine when you're watching a TV from 10 feet away. It's not so great for a PC monitor.

The image processing electronics are also low-end HDTV fare. To cut a long story short, interference patterns are visible, if only just, on the Windows desktop. If any other monitor here exhibited the same issue, it would be instant death for its prospects. That it's somehow acceptable on this screen tells you just how fantastic the upsides are. It's not for everyone—in some ways, it's deeply flawed—but for some of you, we're pretty sure nothing else will do.

VERDICT

8

Philips BDM4065UC

⊞ **ULTRA HD** Big really is beautiful.

⊟ **CHEAP TV** Just don't look too closely.

$782, www.usa.philips.com

Viewsonic VG2860MHL-4K

Packing in the pixels

JUST A FEW YEARS AGO, the very notion of a PC monitor with a TN panel at this price point would have seemed preposterous. But that was then. Here and now, the Viewsonic VG2860MHL-4K packs far more punch than we'd previously have thought possible.

For starters, there's that glorious 4K pixel grid. Yup, that's 3,840 by 2,160 pixels, or a grand total of 8,294,400 of the multi-colored suckers. Factor in each RGB subpixel, and you can triple that total. Staggering.

The G2860MHL-4K also measures a full 28 inches across, and sports a high-quality stand with tilt, swivel, height, and pivot adjustment. Throw in a few extras, such as MHL display input, and you have a strong package, even if it's offset by mediocre image quality from the TN panel.

Except that's not the case. Like other 28-inch 4K monitors, the VG2860MHL-4K takes TN panel technology to a whole new level. It still lags significantly behind IPS for breadth of viewing angles, but colors and contrast are off the charts for a TN screen, and in a good way. The very best in terms of color accuracy still requires an IPS panel, but we could happily live with the vivid colors and solid contrast this screen cranks out. The in-game detail delivered by those eight million pixels is a sight to behold.

If there is a catch, it involves the flip side to 4K. For gamers, the problem is driving all those pixels at a decent frame rate. That's a very big ask for today's graphics, even if we are expecting a new generation of 4K-friendly GPUs to appear later in 2016. For everyone else, the issue is the ongoing inability of Windows 10 to handle scaling with genuine aplomb. That means you have a choice between running at 100 percent DPI settings and dealing with tiny fonts and icons, or stepping the scaling up a notch or two and suffering the odd blurry bitmap or broken menu. Either way, that's not ideal.

VERDICT

8

Viewsonic VG2860MHL-4K

⊞ **HIGH END** Eight million pixels.

⊟ **DEAD END** It'll kill your GPU.

$579, www.viewsonic.com

HOW WE TESTED

If you're a serious graphics professional who demands the very last word in color accuracy, then you will need a fully calibrated screen, and the extra cost that comes with that. For the rest of us, it's the subjective experience that counts. Our assessments cover visual performance in Windows with apps, watching movies, and playing games. We do use a suite of test images to provide some objective baselines, and we allow each monitor a modicum of simple setup tweaks to achieve good image quality. But being in possession of this many screens at the same time is also a huge help. The ability to run two competing screens side-by-side reveals subtle subjective differences that would otherwise be difficult to spot.

SPECIFICATIONS

	Acer XR341CK	**AOC G2260VWQ6**	**AOC I2276VWM**	**AOC U3477PQU**	**Asus ROG Swift PG278Q**	**Asus ROG Swift PG279Q**
Size	34-inch	21.5-inch	21.5-inch	34-inch	27-inch	27-inch
Native Resolution	3440x1440	1920x1080	1920x1080	3440x1440	2560x1440	2560x1440
Panel Type	IPS	TN	IPS	IPS	TN	IPS
Refresh Rate	75Hz	75Hz	60Hz	60Hz	144Hz	165Hz
Adaptive Sync	AMD FreeSync	AMD FreeSync	No	No	Nvidia G-Sync	Nvidia G-Sync
Contrast	1000:1	1000:1	1000:1	1000:1	1000:1	1000:1
Brightness	300cd/m^2	250cd/m^2	250cd/m^2	320cd/m^2	350cd/m^2	350cd/m^2
Pixel Response	4ms	1ms	5ms	5ms	1ms	4ms
Inputs	DisplayPort, Mini Display Port, HDMI 2.0, HDMI 1.4, MHL	DisplayPort, HDMI, VGA	HDMI, VGA	DisplayPort, HDMI, DVI, VGA	DisplayPort	DisplayPort, HDMI
VESA Mount	100mm	100mm	100mm	100mm	100mm	100mm

SPECIFICATIONS

KICK ASS!

	BenQ GW2765	**BenQ RL2755HM**	**BenQ XL2730Z**	**Philips 227E**	**Philips BDM4065UC**	**Viewsonic VG2860MHL-4K**
Size	27-inch	27-inch	27-inch	21.5-inch	40-inch	28-inch
Native Resolution	2560x1440	1920x1080	2560x1440	1920x1080	3840x2160	3840x2160
Panel Type	IPS	TN	TN	IPS	VA	TN
Refresh Rate	60Hz	60Hz	144Hz	60Hz	60Hz	60Hz
Adaptive Sync	No	No	AMD FreeSync	No	No	No
Contrast	1000:1	1000:1	1000:1	1000:1	5000:1	1000:1
Brightness	350cd/m^2	300cd/m^2	350cd/m^2	250cd/m^2	300cd/m^2	300cd/m^2
Pixel Response	4ms	1ms	1ms	5ms	3ms	2ms
Inputs	DisplayPort, HDMI, DVI, VGA	2x HDMI, DVI, VGA	DisplayPort, HDMI 2.0, HDMI 1.4, DVI, VGA	HDMI, DVI, VGA	DisplayPort, Mini Display Port, HDMI, MHL, VGA	DisplayPort, HDMI, MHL, DVI
VESA Mount	100mm	100mm	100mm	No	200mm	100mm

And the winner is...

BenQ GW2765

IF THERE'S ONE THING to take away from this dynamic dozen, it's that there has never, ever been a better time to buy a PC monitor. There's more choice than ever before. There's more technical innovation than ever before. You get more for your money than ever before. It's win, win, win.

There is, however, a catch. The huge range of shapes and sizes can actually be a problem. Firstly, it can be difficult to know what you really want. Secondly, once you do wrap your head around all the options, you may find the precise combination of panel size and type, along with features such as refresh rates, frame syncing, and certain native resolutions, may not actually be available.

Hopefully, we've helped you with the first bit this month, with this gathering of monitors that cover an awful lot of bases, from super-cheap 22-inch panels up to 40-inch 4K monsters. Food for thought, for sure. Our first piece of advice therefore involves clarity. Not clarity of panel quality, but clarity of mind. You need to think carefully about your priorities.

Most PCs are multi-purpose rigs. That's the beauty of the PC: its ability to do everything from serious computation to frivolous gaming. But if, as a for instance, your gaming is of the casual or occasional variety, does it make sense to compromise image quality and desktop real estate in return for smoother, high-refresh gaming? Because, right now, you can't have it all. That 40-inch, 4K 144Hz, IPS, G-Sync screen simply does not exist.

With that in mind, the screen we pick as an overall winner might be the best all round in terms of value, features, and performance, but it still might not be perfect for your needs. Whatever—where there are winners, there must be losers, and the first to fall are the trio of 22-inch budget screens from Philips and AOC. All three are great value, if that's as far as your money stretches. But likewise, all three are cheap for a reason.

The same goes for the BenQ RL2755HM. At 27 inches, it's a huge amount of monitor for the money. But with its modest 1080p resolution and old-school TN image quality, it's also very clearly compromised. From here, every other screen makes a half-decent case for itself regardless of price. And from here, the competition gets tough.

The next to go is a group of screens that all offer something very special, but do not deliver truly mainstream appeal. First, we'll discard the two 27-inch 1440p monitors with high refresh and adaptive sync support—the Asus ROG Swift PG278Q and BenQ XL2730Z. For gamers who demand the most responsive screen and the smoothest frame rates, these two are actually the pick of the bunch. But that's a niche that not even all gamers fall into. So off they go.

Next for the knife are the two 4K screens. The Viewsonic VG2860MHL-4K is fantastic value, and a lovely screen, but 4K and 28 inches is a tricky combination, and as much as TN panel technology has improved, some shortcomings remain. As for the Philips BDM4065UC, its combination of 4K and 40 inches will make it the easy winner for those who want the biggest display and the highest resolutions. They'll be willing to put up with the flaws. But flawed it most definitely is.

The 34-inch superwide displays don't quite make it to the final showdown either. AOC's U3477PQU scores for value for money, while the Acer XR341CK parries with the stunning overall impact of its curved panel and gaming-friendly features. It's a stunner. Which brings us, finally, to the two 27-inch 1440p IPS displays.

This is no coincidence. In many ways, this form factor is the best current compromise between size, fidelity, and desktop real estate. But our winner cannot be the Asus ROG Swift PG279Q. It is a truly fantastic display that brings together a huge range of features and technologies, and combines them with excellent IPS image quality. But it's also in excess of twice the price of the fantastic, the beautiful, and the ridiculously affordable BenQ GW2765. It is a very worthy winner. ⏻

VALVE'S CONSOLE KILLER

Steam, stream, or build for your screen

By Zak Storey

The last two years have seen an almighty stirring in the foundries buried in Valve's heartland. Mutterings on the breeze of a new operating system to rival the mighty Windows 10. A platform built and developed—from the ground up—for gamers, by gamers. Yep, you guessed right: That murmur on the wind was none other than Valve's SteamOS, making its first foray into the spotlight. November 2015 saw its official launch into market and out of beta, and by golly, what a launch the Linux-based operating system has had. In case you forgot, this is an OS that was meant to take the world by storm, transforming living-room gaming irrevocably forever, and providing PC enthusiasts with a suitable solution to all of their console woes. After all, what could go wrong, when it's from the curators and masterminds of the greatest archive of PC games the planet has ever seen?

Many questions still remain, and many secrets still lie deep within the murky code surrounding the Debian-based operating system. Should you spend your hard-earned cash on one of these new glorified gaming PCs for your living room? Is SteamOS better than Microsoft's now thoroughly cemented ecosystem? And what is it actually like? Well, don't you worry, because we've got you covered. And with SteamOS laid bare, we'll pick apart everything Valve has to offer with its new OS, enabling you to decide whether or not it holds a candle to the notoriety Microsoft has achieved over the last three decades. And whether or not you should commit to this new, half-baked platform, which lies somewhere between the real, red meat of true PC gaming and the Quorn meat-substitute of consoles.

WHAT IS STEAMOS?

In short, SteamOS is a custom fork of Linux's Debian "Jesse" distribution, and Valve started development on it in early 2013. Designed to be installed on custom or bespoke HTPC-style builds in your living room, the intention was for the operating system to provide an almost console-like experience, while providing all the advantages and perks usually associated with a higher-end gaming PC. The aim was also to provide users with access to the vast archive of PC exclusives that are unavailable to the console market.

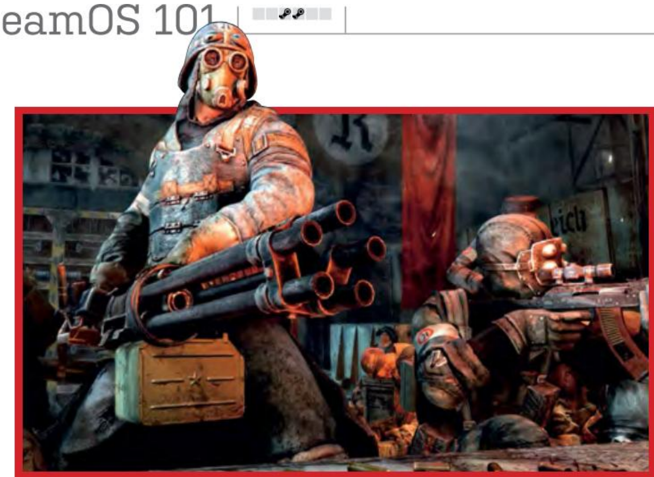
Another added benefit for those not looking to splurge on a secondary living-room PC is the ability to stream your games between your main PC tower and elsewhere in the house, usually direct to your TV. Although there have been some concerns with latency issues over wireless, this feature has been relatively successful, especially on Windows, with a solid, dependable network.

One of the biggest questions asked of Valve was why it opted for Debian "Jesse" as its particular Linux distribution package? After all, Linux users are recommended to run the Ubuntu Linux distro if they want the most compatible software package for Steam games. According to Valve, the choice of distro was to provide users with a complete custom SteamOS experience. Debian was the easiest platform for Valve to work with, providing the team with a good basis to build a completely custom, unique user interface.

THE STEAM ECOSYSTEM

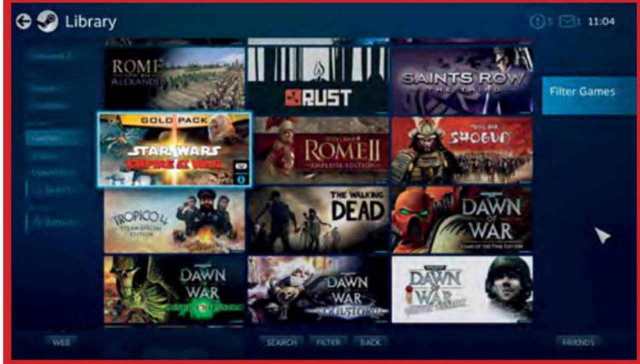
There's no doubt that you're already aware of what Steam is. We won't go into too much detail here because, let's face it, unless you've been living under a rock, it's not like you don't know how this particular application works.

Back to the topic at hand, then—the first knowledge we had of this new operating system came from LinuxCon, back in September 2013. Our lord savior

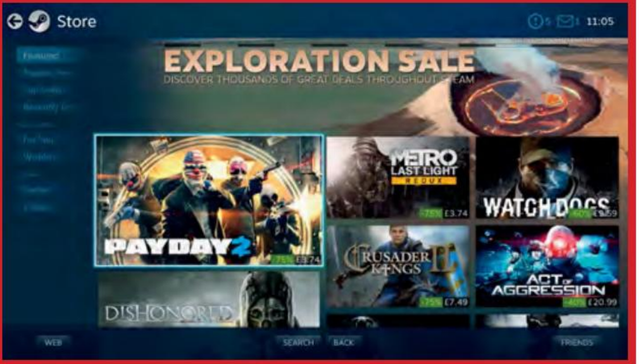


Video settings under SteamOS tend to be limited—*Metro Last Light* has a single "quality" slider. Edit the Config file for more options.

We found SteamOS's *Shadow of Mordor* ran 30fps slower than its Windows equivalent, using a GTX 980 and Core i7-6700K @ 1080p.



SteamOS and Big Picture mode under Windows don't differ much, and both are fantastically easy to use with a controller.



You've gotta take your hat off to Valve when it comes to how well this interface has been put together—it's a pleasure to use.

Gabe Newell announced that he believed open source was the future of gaming. The following months would see the announcement and release of the first batch of SteamOS betas. Valve stated that it would help any game developers who were interested in supporting their latest titles on the Linux platform, to ensure gamers got the experience they deserved.

Then, of course, came the hints of a new controller to take advantage of Steam's sortie into this innovative first attempt at a dedicated gaming platform. Primarily, it was developed to address some of the concerns PC gamers had with regard to playing mouse-driven titles and RTS games, which otherwise weren't available on consoles because of this very problem. The *Total War* series, *Civilization*, *City Skylines*—they all suffered when utilizing a standard controller. Steam's haptic touchpads provided an intuitive new way of using the mouse cursor on a controller, without losing too much of the functionality. You might not be hitting the 300 APM that's associated with pro gamers, but for casual and light gaming, it's more than enough to play comfortably.

And then, rounding off Steam's new ecosystem, came the Steam boxes from the vast multitude of system integrators around the globe. Custom-designed, small-form-factor, living-room PCs, in short. Coming with SteamOS as standard, these miniature powerhouses provide a comparable or even better experience than the console climate, and for a reasonable price.

If none of that piques your interest, and you don't want to drop $700 on a living-room gaming machine, you could always opt for the Steam Link instead. This gizmo gives you the ability to stream content straight to your living-room TV from your PC. Of course, the one downside of this is that your PC needs to be switched on for this to happen, and no one else can use it at the same time. However, it works much the same way as gaming on a Steam Machine does, and you also benefit from the extra horsepower your big rig's GPU can muster.

INSTALLING STEAMOS

In our experience, installing SteamOS has been painful. Although it's come a long way from the days of its entry into early beta, we were still encountering numerous problems recently, even just finding compatible hardware. But if you're interested in trying it out for yourself, read on....

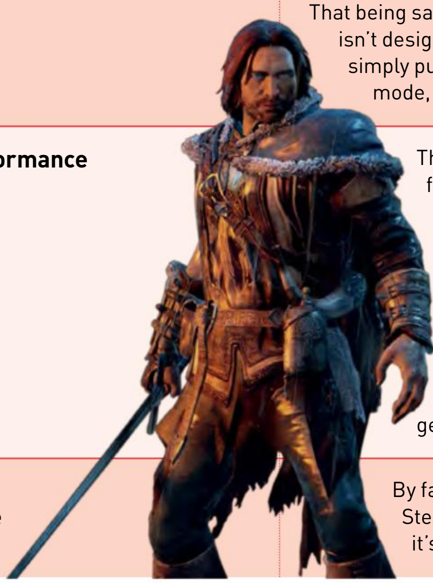
To start, you're going to want to grab yourself a formatted FAT32 USB stick—8GB or more. Then you have to head over to

MINIMUM SPECIFICATION REQUIREMENTS FOR STEAMOS

Processor	Intel or AMD 64-bit capable processor
Memory	4GB or more
Hard Drive	200GB or larger
Video Card	Nvidia or AMD GPU (Radeon 8500 and later), or Intel Graphics
Additional	USB port for installation, UEFI firmware

Steam OS vs. Windows 10

	SteamOS	Windows 10
Driver Support	Unfortunately, SteamOS has limited support for graphics and chipset drivers. This is mostly down to the general lack of support for Linux drivers in general from the main manufacturers. Any drivers for SteamOS systems have to be tested, repackaged, and updated directly by Valve after the initial system image has been installed. This is done to ensure SteamOS remains compatible with the Debian distribution. Expect to be four or five driver updates behind current Windows 10 WHQL releases.	Still the king when it comes to driver support. According to the Steam Survey, Windows accounts for over 95 percent of all Steam users. Thanks to being the golden child of PC gaming, Windows 10 will always have better-performing drivers than its Linux rivals. And that's a statistic that, for the time being at least, doesn't look likely to change.
Game Support	Although Linux support has come a long way over the last two years, it still suffers if you're looking to play some of the latest titles. This is mostly down to the development teams behind the games. If you're hoping to play games such as *The Witcher 3, Skyrim,* or any of the *Total War* series, you're in for a long wait.	Short of some unfathomable, unannounced exclusives, you're unlikely to find any games in Steam's arsenal that aren't available to play on Windows 10.
Origin and Battlenet	Not likely to happen anytime soon. Although there haven't been any official statements from either EA or Blizzard, we can assume that, as competitors, they're just not interested. No *StarCraft, Hearthstone, WoW,* or *Battlefield* for you.	Thankfully long-gone are the days of Games for Windows Live. Steam, Battlenet, Origin, Ubisoft, you name it—if it's a proprietary games archive, there's no doubt that you can run it.
Other Uses	SteamOS is a full Linux install, so by all means, feel free to add the repositories for any and all available programs. That being said, this particular fork isn't designed to be used this way—simply put, it's Steam Big Picture mode, and that's about it.	Windows supports the lot. Got a program? Windows can run it. Don't believe what Team Apple says—productivity is just as effective on a high-powered Windows machine as it is on any Mac.
Performance	The biggest problem for SteamOS lies in driver updates and compatibility. Being four or five driver updates behind will only hurt performance in-game. And that's not even considering how well optimized games are, in general, on the two platforms.	Windows is leaps and bounds ahead of its rival in this test. Mostly because of those graphics driver updates, but also because of the amount of time developers put into optimizing games for Windows.
Price	By far the biggest perk of SteamOS is the fact that it's free.	Unfortunately, unless you've got a copy of Windows XP or above, a new copy of Windows 10 will set you back at least $99.



SteelSeries + Xbox + Steam Controllers

SteelSeries Stratus XL Controller

The SteelSeries Stratus XL provides a more traditional take on the PC console controller. It's small, compact, comfortable, and is priced very aggressively for what you get. SteelSeries has made cutbacks to accommodate that low price, however. You lose out on rechargeable batteries and a wireless dongle—Bluetooth-only, unfortunately. But for build quality at that price, the Stratus XL is second to none, and provides a smooth gaming experience, as long as you don't plan to play any RTS games, of course. Overall, it's very similar in design to the PlayStation controller, just with the Xbox button layout.

Xbox Elite Wireless Controller

By far the most expensive of the bunch, the Xbox Elite Controller provides possibly the most comfortable, versatile gaming experience available to date. It's a classic—we all know it, we've all used it. Add in a few extra buttons, hair triggers, and some fancy decal work, and it's by far one of the best-looking hand cannons you can get your mitts on. The only downsides are that it's not rechargeable, the price is quite steep, and it doesn't add too much on top of the traditional Xbox 360 controller. You also have to buy a separate dongle for your PC, or use the included cable.

http://store.steampowered.com/steamos/buildyourown, select the "Download the SteamOS" installation link, and accept the terms and conditions. Once you've got the file downloaded, move it to your desktop and extract it. Then copy and paste it on to your fresh memory stick. At this point, it follows the same methodology as when you install a fresh copy of Windows. Head into the BIOS—with your new USB installer plugged into the rear I/O—select "UEFI:Memory Stick Name" as your first boot option, and restart your machine.

On boot, you should have two options. "Automated install" flat-out formats your entire hard drive, partitions and all, while "Expert install" enables you to select which partition you wish to install SteamOS on, along with a couple of other language and keyboard options. Then it's simply a matter of letting the installer do its thing, and eventually you'll witness a full system restart. Once you've logged in, you need to be connected to the Internet. If you have to use Wi-Fi, you need to close the immediate window, and head to the network configuration UI on the desktop, where you can configure your wireless network. Then Steam finishes the installation, and voilà—job done, hopefully.

THE LIVING-ROOM ECOSYSTEM

As we've established, SteamOS is designed around one thing and one thing only: living-room gaming. This isn't a new concept; consoles rule the roost when it comes to that particular ecosystem. In fact, it probably wouldn't exist at all without the likes of Sony, Nintendo, and Microsoft duking it out in the ongoing console war. PC enthusiasts, on the other hand, have had it worse in this regard. Yes, there have been home theater PCs and the like for some time, but they hardly serve as gaming machines, just fancy DVD players. The biggest problem is getting around the Windows UI. It's ideal for productivity, using a keyboard and mouse, but dragging those peripherals on to your couch is less than ideal. It's easier nowadays with wireless keyboard combos, granted, but they still don't give you anywhere near as much precision as a controller does with a big UI.

So with living-room gaming and SteamOS becoming more popular, it's about time there were some gaming peripherals designed to work around that. Whether that's through Steam, SteelSeries, or Microsoft, you're certainly spoiled for choice when it comes to the controller conundrum, and choosing the right controller for you might be more difficult than you think.

TO CAP IT ALL OFF

Regardless of how you look at it, the PC is still king. If you want the best performance, the most versatility, and the largest games library, your best bet is to hook yourself up with a high-powered Windows 10 gaming machine: 1080p, 1440p, 4K—the world is your oyster. But we knew that anyway. If Steam's interface and Big Picture mode are still your jam, but you just can't give up those extra frames, turning on "Big Picture" mode in Windows serves just as well, if not better than its Linux counterpart.

In the long run, Gabe's fantasy of open-source software being the future of gaming is a potential reality. But for the time being at least, and with figures like those we've seen in our testing, there's simply no contest between the two platforms. A 40 percent drop in performance is just not worth it, no matter what anyone tells you.

Steam Controller

The Steam Controller provides you with unprecedented accuracy, thanks to its touch-sensitive, haptic feedback-enabled trackpads, located on either side of the device. This allows for exceptional versatility in top-down RTS games, compared to the other two controllers here. Couple that with wireless and cabled options as well, and you're good to go. The only disadvantage—other than the time it takes to get used to it—is the latency issue between the controller and Steam Link. But that's no doubt going to be patched sometime soon....

Keyboard & Mouse Substitutes

What if you're a die-hard fan of the precision mouse, but still want to dip your toes in the waters of living-room gaming? Let's forget SteamOS for a second, take a step back, and consider the whole shebang. Surely, by this point, there are peripheral manufacturers who have created living-room mice and keyboard combos? The answer is yes. If you're determined to game in the living room, Corsair and Razer have two alternatives to those pesky button-mashers.

For Razer, that's the Turret. It's a wireless, chiclet keyboard, with a magnetic gaming mouse, embedded into a solid lapboard, which folds up and fits snuggly into a dock that you place by your TV to charge. This is possibly the best solution out there. OK, it's not a mechanical keyboard, but that means it's not clunky.

If you can't live without the clickety-clack of Cherry MX switches, Corsair has a solution in the form of the Lapdog—a product soon to be tandem-launched with its Bulldog 4K living-room gaming machine. Unlike Razer's Turret, the Lapdog provides a fully mechanical experience, utilizing a Corsair Gaming K65 RGB keyboard, and a fully powered USB hub embedded into the board. Downsides? Well, the mouse isn't magnetic, and you are burdened by a single USB wire trailing in front of you, but it's a sound product, with some impressive cable management integrated into the design.

Unfortunately, you won't be hooking yourself up with an SSD inside of this bad boy. Think of it more as a stream box.

Alternatives to Build-It-Yourself Systems

In reality, the long-term goal for Steam has never been about our kind, the machine builders. Its goal is to provide consoles, in the same way Sony and Microsoft do with the PS4 and Xbox One. In partnership with companies such as Cyberpower, Alienware, and Zotac, Steam offers machines that include all levels of hardware. If you want to drop $449 on an Intel Core i3, 4GB RAM, and an undisclosed Nvidia GeForce GTX GPU, you can do that with Alienware. Fancy stepping up a smidge and flashing the cash at a Zotac NEN? Then you can grab yourself an i5 and a not too shabby, full-fledged GTX 960. Going all-out? Then there's Cyberpower's behemoth builds, capable of featuring anything from R9 380s all the way up to the Titan X. And that's Valve's ultimate goal: Similar to Nvidia and the Shield, it's not about capturing the pro gamers and hardware enthusiasts, but about bringing over the mobile gamers and those people who are simply looking for something a little more than the consoles currently have to offer.

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TECH PORN

1 Now really wireless

Originally, the Xbox One controller needed to be wired to function on PC, but thanks to the new wireless adapter, those days are behind us. You can still go wired, but the wireless capabilities make it a much more pleasant device to use. And it is a beautiful thing to behold—from the extra physical weight to the rubberized grips to the motion in the new analog sticks, the Elite Controller screams quality.

Xbox Elite Wireless Controller

THE ORIGINAL XBOX ONE CONTROLLER is the benchmark for PC gamepads. It's beautifully made, ergonomically pleasing, and brilliantly supported by PC gaming in general. Sony's DualShock 4 is the closest rival, sporting slicker analog sticks but weaker trigger buttons, and is far less supported on our favorite machine—although there are ways of getting it up and gaming if you're prepared to put in the time.

Microsoft wants to kick the DS4 into third place, though, and has released its super-expensive Elite Controller, building on all that is good about the standard gamepad, and taking it even further. The problem, however, is that while it is undoubtedly an excellent pad, Microsoft hasn't made enough of them. Take a look at Amazon, and you'll see that even the behemoth online store is struggling with demand—order one right now, and you're not going to get it until some time in the spring. Look on eBay, and you might be able to find one retailing for anywhere up to $300. Yup, it's that good. –**DAVE JAMES**

2 Thumb war

There are three different types of thumbstick you can choose to attach to your controller. There are the standard ones with concave rubber pads, convex DualShock-style pads, and then extra-long thumbsticks. Why? For when *Street Fighter V* turns up, that's why.

3 Customizable

The Elite Controller is all about customization. The d-pad, thumbsticks, and paddle-buttons on the flipside of the controller are all removable and come with different replacements. And it's not just the controls that are customizable either—you can also adjust the sensitivity of those beautifully smooth trigger buttons, too. Want a hair trigger for close-quarters combat? No problem.

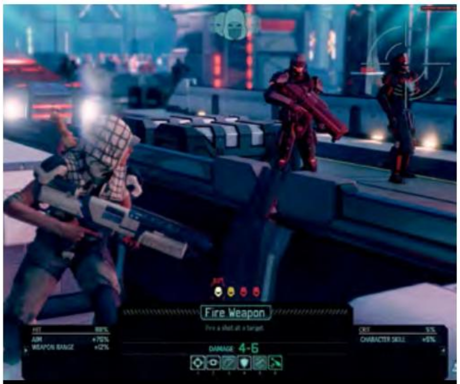
GAMES OF 2016

The finest games due out this year

BY DAN GRILIOPOULOS

WIPE THAT *WITCHER* GREASE FROM YOUR CHIN, clean up the jellied *Metal Gear* leftovers, and stop picking your teeth with that *Fallout* finger bone. Those games are all so last year and, as good consumers, we must discard and burn old games, and only play the newest and shiniest things. Or capitalism will collapse!

More importantly, there's only a five-minute window before some idiot on social media spoils the key plot twist to any newly revealed game. But what new games are coming out soon? Lots! And here are the biggest, brightest, and weirdest for your delectation. Remember: Don't consume them all at once!



XCOM 2

Release date: February 5, 2016

FIRAXIS'S SEQUEL to the best-selling tactical combat sim is going all *Syndicate.* This time around, the aliens have won, and XCOM has been reduced to a terrorist organization, striking back in public. For some reason, this iteration is a PC exclusive, despite the previous game working perfectly well on an iPad. Not that we're complaining....

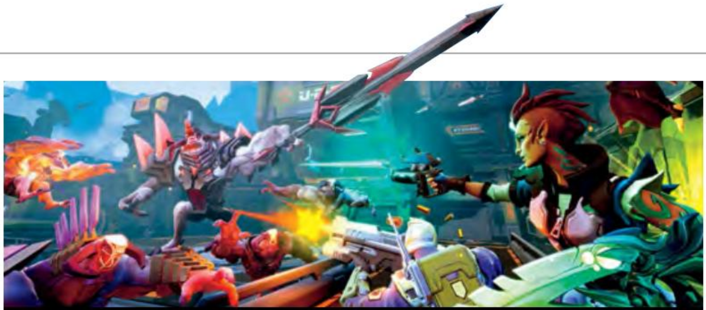
» **Publisher:** 2K » **Developer:** Firaxis

Street Fighter V

Release date: 2016

THE PRE-EMINENT FIGHTING GAME has seen multiple iterations since *Street Fighter IV* shook it up. This edition doesn't change much, but adds yet more characters and more complexity for the skillful. The new V-charge meter enables each character to buff certain types of attack, and have special skillful defenses against others—Bison can reflect projectiles, for example.

» **Publisher:** Capcom » **Developer:** Capcom

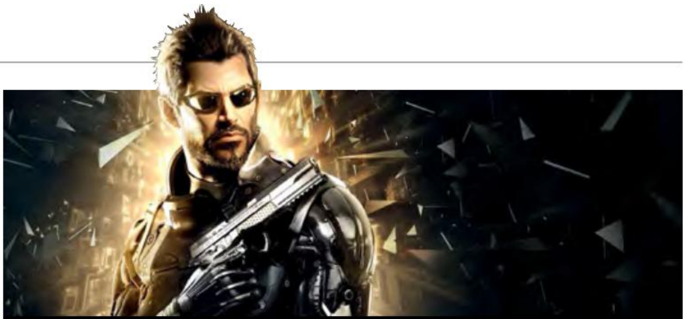


Battleborn

Release date: May 3, 2016

IT SEEMS THAT team arena shooters are the new cool. *Dirty Bomb* led the charge, but *Battleborn* looks more likely to be a serious contender. It takes the kooky design and dialogue of *Borderlands,* marries it to a bright, clear *World of Warcraft* look, and throws up more than 20 weird characters to play as.

» **Publisher:** 2K » **Developer:** Gearbox

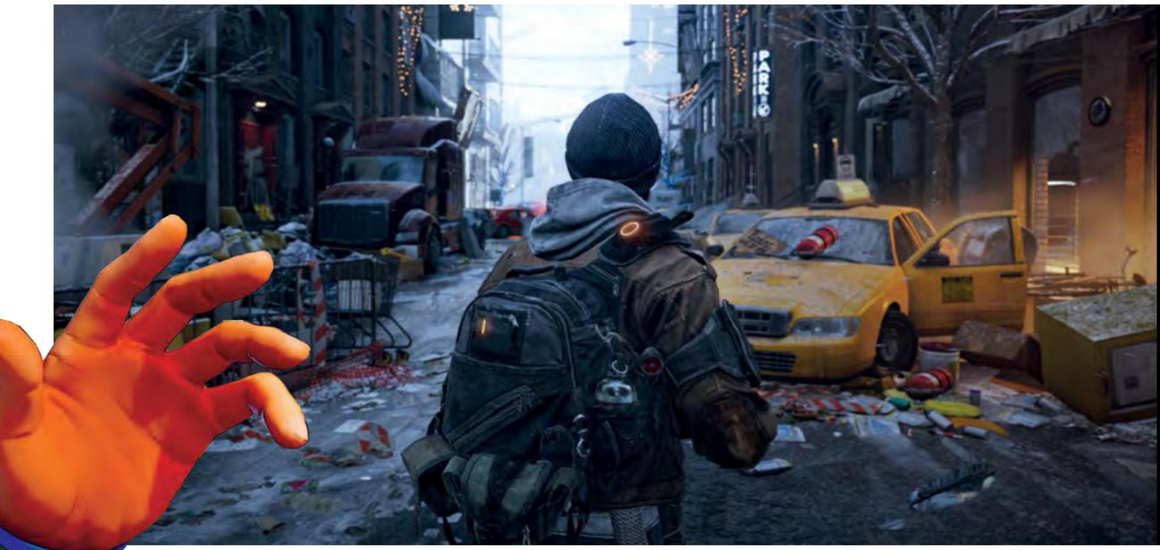


Deus Ex Mankind Divided

Release date: February 23, 2016

FOR *DEUS EX* FANS, more of the *Human Revolution* game is a no-brainer. This time around, protagonist Adam Jensen is struggling with a cyborg rights terrorist group, as well as the shadowy figure behind his own organization.

» **Publisher:** Square Enix » **Developer:** Eidos Montreal



Tom Clancy's The Division

Release date: March 8, 2016

TOM CLANCY may be dead, but his Ghost Recon still haunts the land. *The Division* is a multiplayer open-world RPG shooter, set in a virus-riddled New York. As ever in *Clancy* games, you're part of an extra-judicial team, with special orders from the president to sort out the problem, using any means.

» **Publisher:** Ubisoft

» **Developer:** Ubisoft Massive

Hitman

Release date: March 11, 2016

THE SANDBOX ASSASSINATION series has struggled recently, but this reboot focuses on the core *Hitman* gameplay—a series of small, characterful sandboxes, where you approach assassinations creatively, trying to make them as undetectable as possible, through disguises and "accidents."

» **Publisher:** Square Enix

» **Developer:** IO Interactive

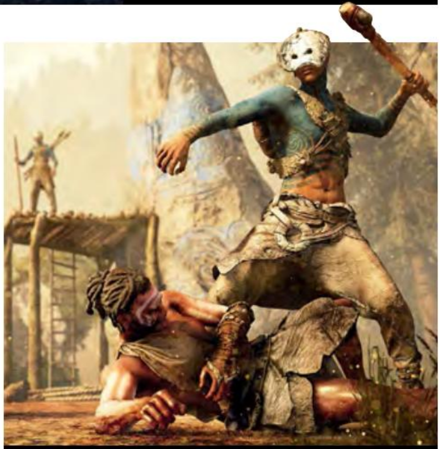
Quantum Break

Release date: April 5, 2016

QUANTUM BREAK is a third-person episodic shooter, tied into a digital TV series, where players have time manipulation powers. Players also get to make choices for the antagonists at the start of each TV episode, affecting the direction of the game.

» **Publisher:** Microsoft

» **Developer:** Remedy



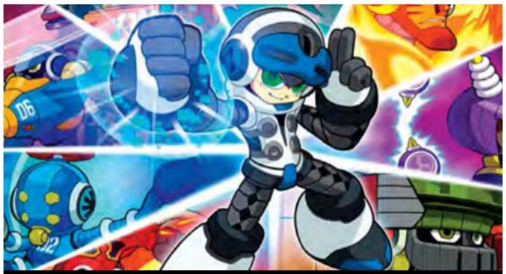
Far Cry Primal

Release date: February 23, 2016

MOST SHOOTERS creep forward in tech, until they end up in a boring sci-fi setting. Not *Far Cry.* Moving from Pacific islands to Africa, then Nepal, now the open-world shooter has stepped back to the Stone Age, where you start as an unarmed hunter attempting to take over his tribe.

» **Publisher:** Ubisoft

» **Developer:** Ubisoft Montreal



Mighty No 9

Release date: February 9, 2016

IT'S NOT A NEW *MEGAMAN,* it's an unofficial *Megaman* from original creator Keiji Inafune. An action platformer, you acquire weapons and abilities from defeated enemies, before fighting the eight previous bots in any order.

» **Publisher**: Deep Silver

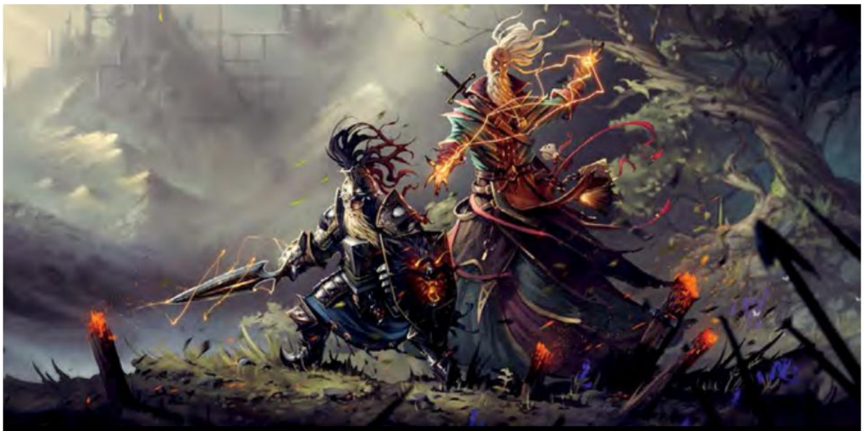
» **Developer**: Comcept/Inti Creates

Planet Coaster

Release date: Autumn 2016

FROM THE DEVELOPERS OF *ELITE,* this is the spiritual sequel to 2004's *RollerCoaster Tycoon 3.* It's a construction and management sim, where you build custom theme parks and rollercoasters. This time around, it's running on the same engine as *Elite: Dangerous,* and players can share their attractions through a "global village."

» **Publisher**: Frontier Developments » **Developer**: Frontier Developments



Divinity: Original Sin 2

Release date: December 2016

DIVINITY: ORIGINAL SIN was a surprise success for its developer, given the mediocrity of earlier titles. The sequel follows four sorcerers attempting to defeat Bishop Alexander, who has declared them outlaws. It involves smart dialogue, a huge world to explore, and a massive branching plot, where you can be whomever you want.

» **Publisher**: Larian Studios » **Developer**: Larian Studios

Overkill's The Walking Dead

Release date: 2016

THE WALKING DEAD guys seem keen on turning their generic zombie comic into a transmedia empire. We've already had TV series, Telltale's adventure game version, and *The Escapists'* odd sandbox version. Now *Payday* developer Overkill is going to turn it into a co-op first-person shooter with stealth and RPG elements.

» **Publisher**: Starbreeze » **Developer**: Overkill

Halo Wars 2

Release date: 2016

THE FIRST *HALO WARS* was a so-so console-focused RTS, set as a prequel to *Halo,* featuring the Earth Spartan forces battling the Covenant. But by enlisting *Total War* developer Creative Assembly for this one, Microsoft has signaled it wants this to be a bigger, smarter title, though still set in the same time period.

» **Publisher**: Microsoft

» **Developer**: Creative Assembly

Lego Worlds

Release date: 2016

THERE HAS BEEN A HUGE NUMBER of successful Lego co-op games—and an equal number of aborted online ones. TT Games made the vast majority of the former, so it's no surprise that it has tried to break the rule by creating a *Minecraft*-esque procedurally-generated sandbox world.

» **Publisher**: Warner Bros » **Developer**: TT Games

Total War: Warhammer

Release date: 2016

FOR YEARS, WARGAMERS have begged Creative Assembly and Games Workshop to produce a *Total Warhammer* game. Finally, it's happening, and the bits we've played are just right—a good combination of giant monsters, ridiculous machines, serried troops, and over-powered wizards, with a campaign where each faction has asymmetric objectives, and heroes have special quests, which unlock magic items. It starts with five factions—Undead, Empire, Dwarfs, Orcs, and Chaos—but many more are to come.

» **Publisher**: Sega
» **Developer:** Creative Assembly

Dishonored 2

Release date: 2016

STEALING THE CLOTHES of *Thief* was impressive, but magic-steampunk first-person RPG *Dishonored* also came with a well-built pseudo–British Empire world, and a solid story (with a stupid twist). This sequel is set 15 years after the first, with you playing as the Empress Emily Kaldwin, dethroned by an otherworldly usurper.

» **Publisher**: Bethesda Softworks
» **Developer**: Arkane

Mirror's Edge: Catalyst

Release date: February 23, 2016

THE ORIGINAL *MIRROR'S EDGE* allowed superb first-person free-running over a unique near-future cityscape. This reboot features an open-world environment for protagonist Faith to traverse, and removes her ability to use weapons, making the game more about evasion than combat.

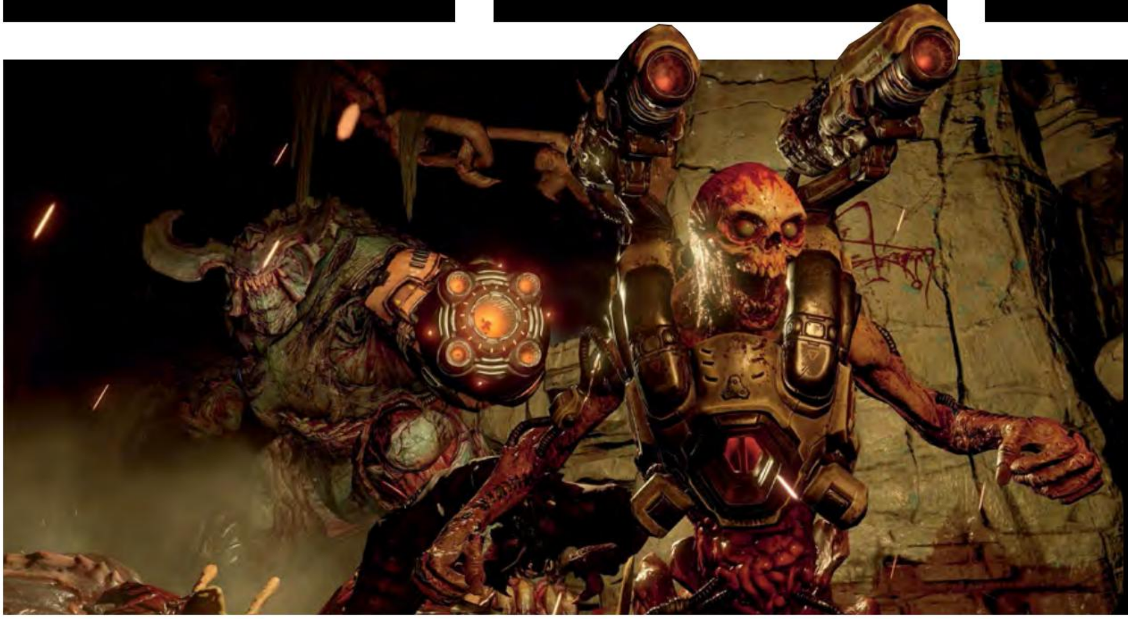
» **Publisher**: EA » **Developer**: EA DICE

South Park: The Fractured, But Whole

Release date: TBA

THE FOLLOW-UP to turn-based RPG *The Stick of Truth*, the *But Whole* replaces the first game's *Lord of the Rings* parody with a superhero pastiche. Expect puerile filth and cutting satire.

» **Publisher:** Ubisoft
» **Developer:** Ubisoft San Francisco



Doom

Release date: 2016

ONCE CALLED *Doom 4*, now plain *Doom*, this is the first new id Software game since founder John Carmack left. Using the latest id Tech engine, the reboot follows the original closely, focusing on killing Mars-bound demons with big guns. Series icons such as the BFG 9000 and Cyberdemon return, and the game focuses on speed and momentum.

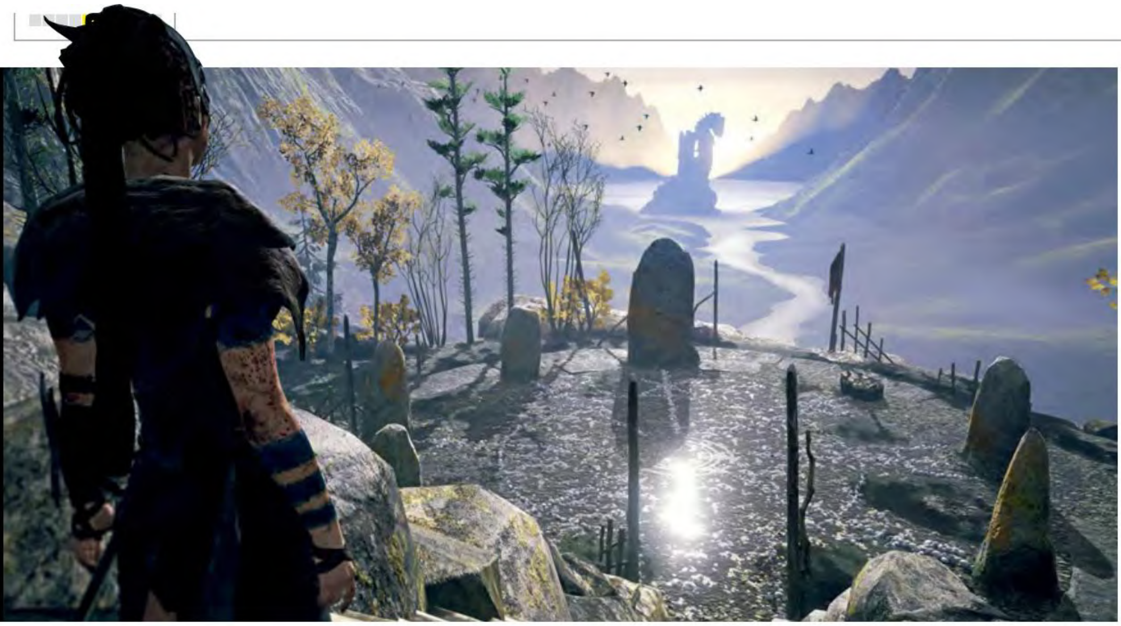
» **Publisher**: Bethesda
» **Developer**: id Software

Hellblade

Release date: 2016

HACK AND SLASH developer Ninja Theory has always met with critical acclaim for its ninja combat and unique art style, but never mass success—not even for its *Devil May Cry* reboot *DmC*. *Hellblade* is based on Celtic myth, and has your character Senua battling psychotic manifestations of her own mind in a hellish underworld. Fun!

» **Publisher**: Ninja Theory
» **Developer**: Ninja Theory



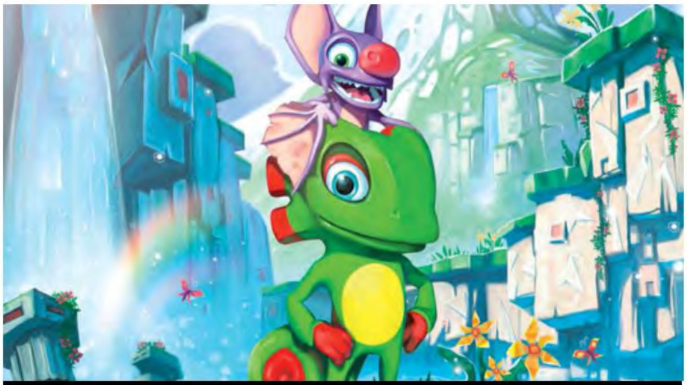
Welcome to
Lunar Transfer Station
TACOMA

Tacoma

Release date: 2016

IN THE STYLE OF FILMS such as *Solaris* or *Sunshine, Tacoma* is from *Gone Home* developer Fullbright, but it's very different from its glossy '80s era predecessor. This time around, you're controlling astronaut Amy Ferrier in 2088, exploring the oddly silent Lunar Transfer Station Tacoma, discovering its fate by watching holographic recordings.

» **Publisher**: Fullbright » **Developer**: Fullbright

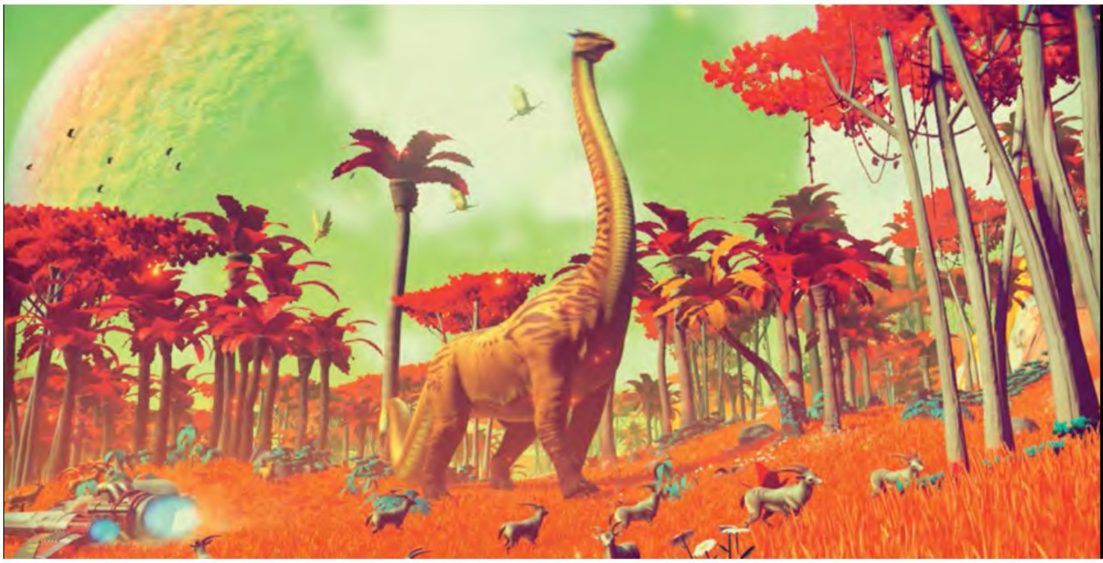


Yooka-Laylee

Release date: October 2016

MANY NINTENDO GAMERS miss the classic games of developer Rare, long since swallowed by Microsoft, but once known for its family-friendly, colorful, and childish games such as *Banjo-Kazooie*. This title from a group of ex-Rare developers, Playtonic, replicates that feeling, as co-op players explore a huge, crazy world by flying, farting, and riding minecarts. It's all very charming.

» **Publisher**: Team 17 » **Developer**: Playtonic Games



No Man's Sky

Release date: June 2016

A STEP-CHANGE FROM its previous light action game *Joe Danger, No Man's Sky* is a procedurally generated universe-exploration game. You can step from the surface of a populated planet into a spaceship, and fly it out into the universe, seeking new worlds to explore and enemies to defeat. No wonder Sony snapped it up for a console exclusive.

» **Publisher**: Hello Games
» **Developer**: Hello Games

Mass Effect: Andromeda

Release date: December 2016

ALTHOUGH THE STORYLINE ended with *Mass Effect 3*, EA continues the sci-fi action-RPG series in an all-new galaxy.

» **Publisher**: EA » **Developer**: Bioware

Man O' War: Corsair

Release date: 2016

ONE OF A BAJILLION LICENSED Games Workshop games coming our way (see also: *Deathwing, Inquisitor, Battlefleet Gothic: Armada, Mordheim*), *Man O' War* is more *Sid Meier's Pirates* in the Old World of *Warhammer Fantasy*. It has you captaining a corsair ship, complete with its normal crew of sharpshooters, monsters, and wizards, and battling other vessels and giant sea monsters.

» **Publisher**: Evil Twin Artworks » **Developer**: Evil Twin Artworks

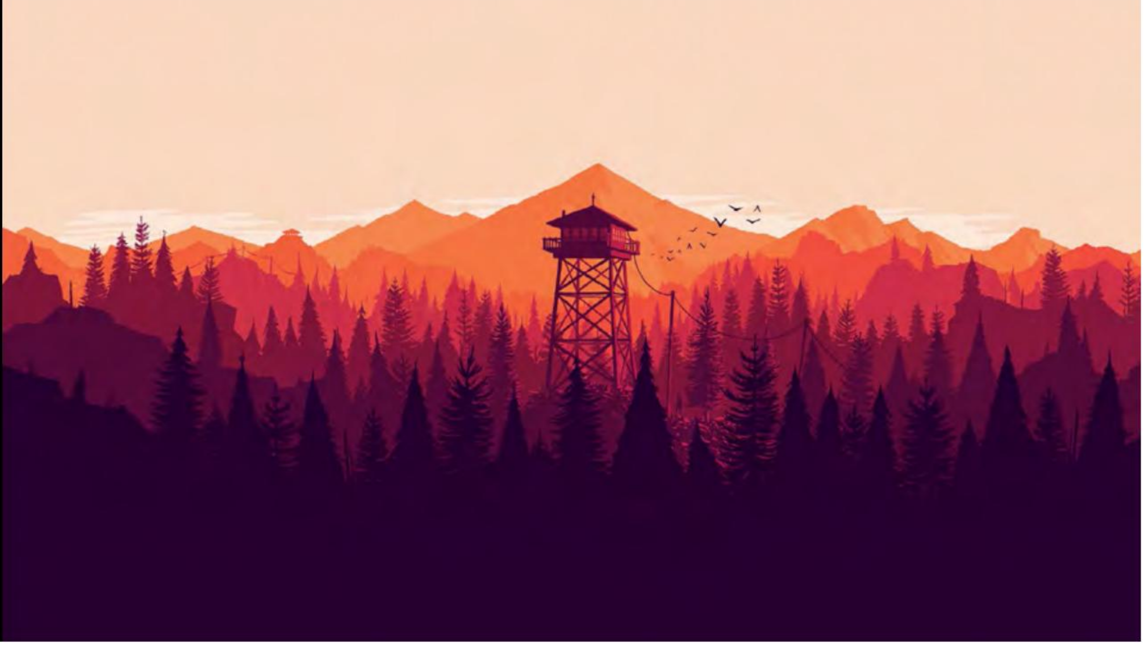
Firewatch

Release date: 2016

ANOTHER STRANGE first-person indie game, players take the part of a volunteer fire lookout in the Wyoming Wilderness, isolated save for a walkie-talkie to talk to your supervisor. When something draws you out of the tower, you'll have to use your orienteering skills to survive in the wilderness.

» **Publisher**: Campo Santo

» **Developer**: Campo Santo



Hyper Light Drifter

Release date: Spring 2016

AN UNTRIED BUNCH of indies making a truly lovely looking 8-bit action adventure game. You must explore a huge, lush, ruined world, riddled with ancient technologies and unforeseen peril. Much like *Transistor* or *Zelda*, the game appears to be a mix of carefully timed actions and dangerous exploration.

» **Publisher**: Heart Machine

» **Developer**: Heart Machine

Dark Souls III

Release date: March 24, 2016

THE HARD-AS-NAILS ACTION-RPG returns for another foray on the PC, in the wake of the superior PS4-exclusive *Bloodborne* from the same team. The difference this time is more fluid, quick combat, as well as a more involved magic system.

» **Publisher**: From Software

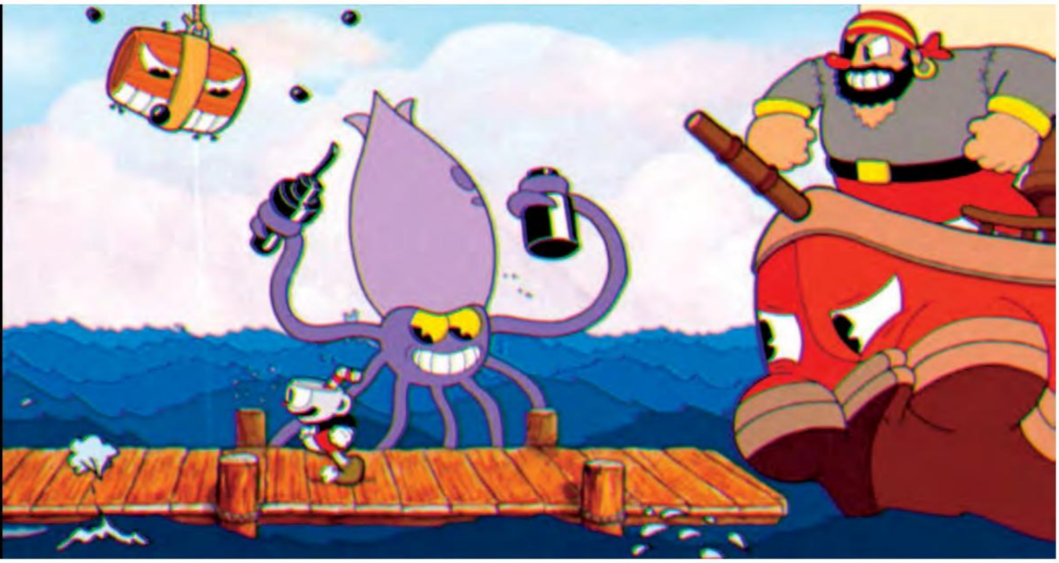
» **Developer**: From Software

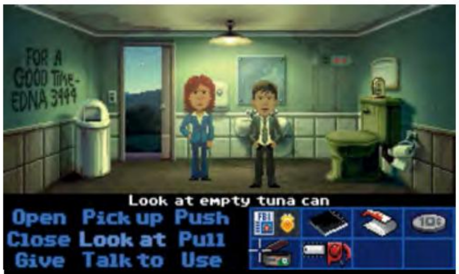
Cuphead in Don't Deal With The Devil

Release date: 2016

YES, THE GAME really does look like that. Cuphead and Mugman have lost a dice game to the devil, so they have to battle an array of his enemies. Based on 1930s animations, the game looks utterly beautiful, complete with poor film stock and title cards. The actual co-op gameplay is part-platformer, part bullet-hell shooter, all amazing.

» **Publisher**: Studio MDHR
» **Developer:** Studio MDHR



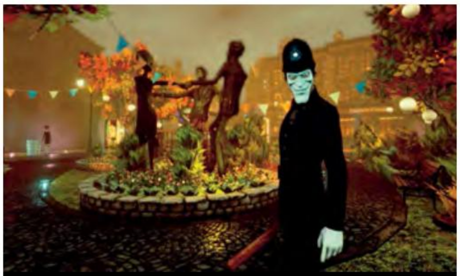


Thimbleweed Park

Release date: July 2016

WE'RE SEEING A LOT of spiritual sequels these days—this one is by the designers of *Maniac Mansion* and *Monkey Island,* and it's a classic early '90s LucasArts-style adventure. You play two washed-up detectives investigating a washed-up corpse on the outskirts of the dusty, abandoned town of Thimbleweed Park.

» **Publisher**: Gary Winnick
» **Developer**: Gary Winnick



We Happy Few

Release date: June 2016

A GAME OF PARANOIA and survival in a drugged-out dystopian English city in the mid '60s, *We Happy Few* is reminiscent of both *Bioshock* and *The Stepford Wives*—a procedurally generated, first-person game about trying to blend into a society where everyone else is on happy pills, and where they'll kill you for standing out.

» **Publisher**: Compulsion Games
» **Developer**: Compulsion Games

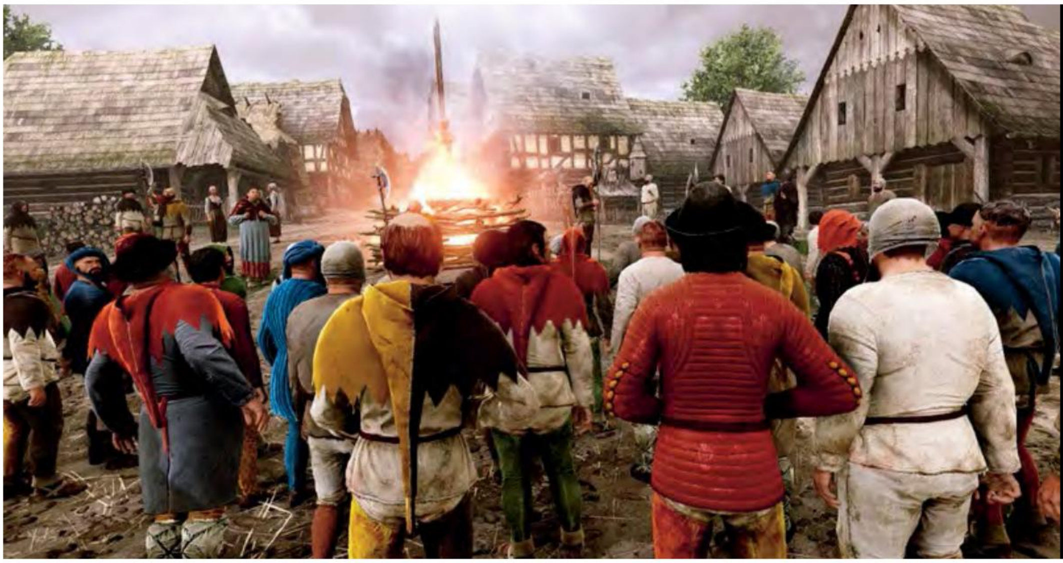
NAR
WHT
RATE
1183
10C: A
ACFT
N
W
16TC
UPN:G19
RND:OK
MAG:LOW
SPC
F:OK
W:OK
H:OK

Noct

Release date: 2016

THE SCREENSHOT doesn't look like much, but it's part of a trend to release games that use all a PC's graphical juices to make it really hard to see what's going on. *Noct* is a top-down horror shooter, set in an Earth trapped for an age in darkness. You're a rare human survivor, battling to live in this wasteland.

» **Publisher:** Devolver
» **Developer:** C3SK

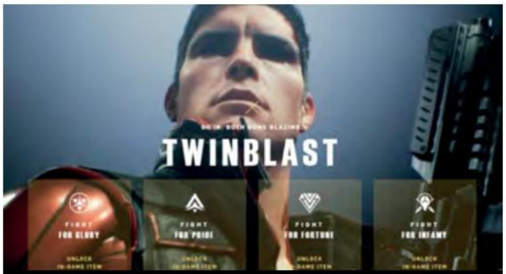


Kingdom Come: Deliverance

Release date: Summer 2016

A FIRST-PERSON REALISTIC RPG set in a realistic medieval open world, *KC: D* is being made by an all-star team of veteran Czech developers. As a blacksmith who's lost everything to war, you get dragged into a conspiracy to save a kidnapped king. With branching quests and period-accurate equipment, the game sounds both dauntingly huge and very, very grim indeed.

» **Publisher**: Warhorse
» **Developer**: Warhorse

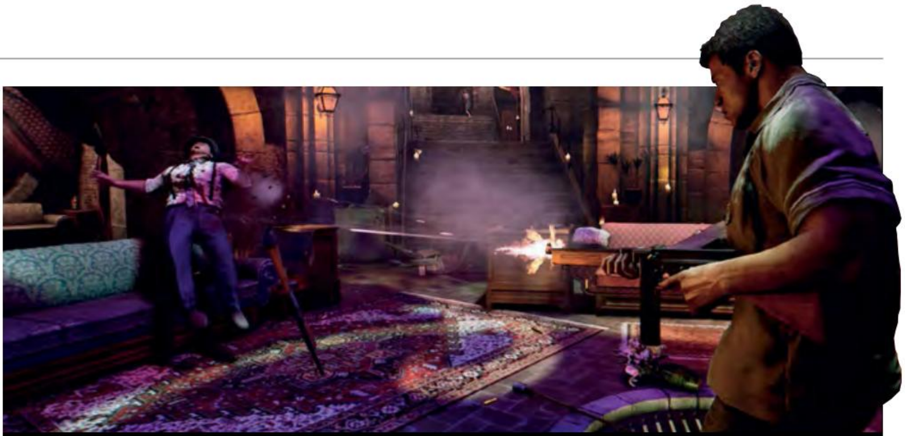


Paragon

Release date: 2016

ANOTHER TEAM-BASED SHOOTER perhaps? We don't know yet, because Epic has so far only shown off some ridiculously high-resolution videos of the characters looking lovely, rather than any gameplay.

» **Publisher**: Epic Games
» **Developer**: Epic Games

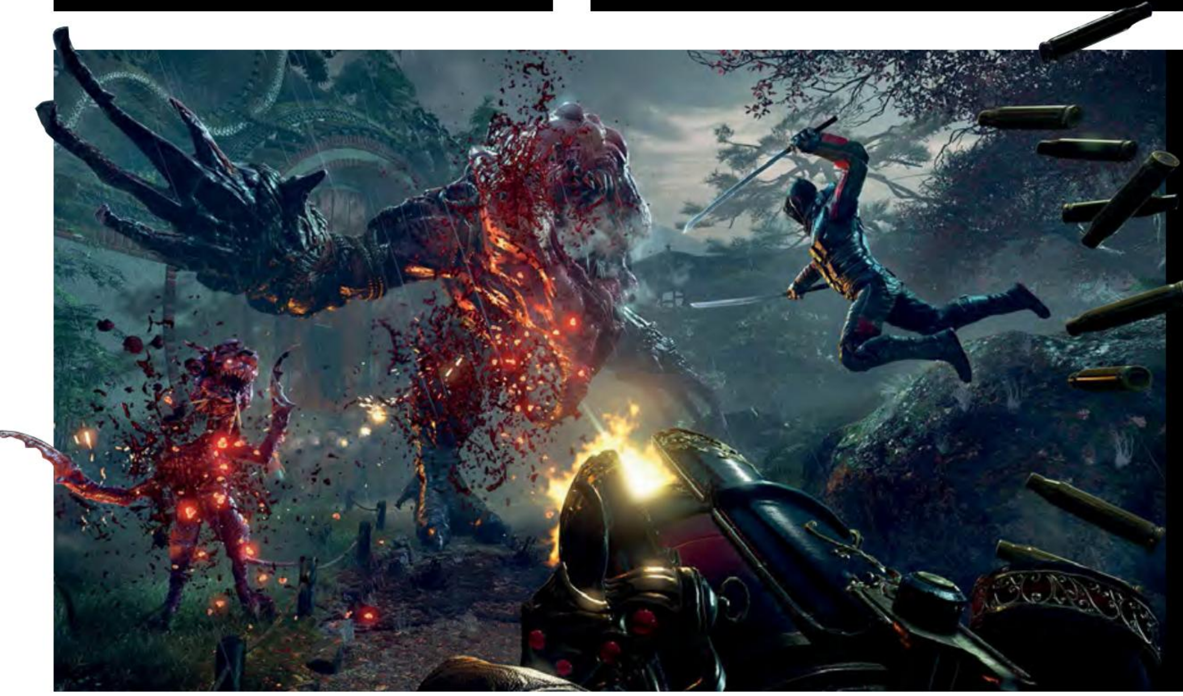


Mafia III

Release date: 2016

MOVING THE OPEN-WORLD COMBAT *Mafia* series from its Italian-American roots to 1968 New Orleans, this third installment has left the original developer Illusion Softworks (which 2K has shut), and is being developed by a new studio. You take the role of Lincoln Clay, a Vietnam War vet seeking revenge on the Italian Mob—by any means possible.

» **Publisher**: 2K » **Developer**: Hangar 13



Shadow Warrior 2

Release date: 2016

CONTINUING DEVOLVER'S trend of publishing the most bloody games around, *Shadow Warrior 2* follows on from last year's excellent *Shadow Warrior* reboot. Five years after the first game, demons and humans live uncomfortably side-by-side on Earth. Four players can now slice and dice demons, with procedural generation meaning the game world is always shifting.

» **Publisher**: Devolver
» **Developer**: Flying Wild Hog

The Witness

Release date: Jan 26, 2016

WE FIRST PLAYED *Braid* creator Jonathan Blow's strange exploration game five years ago. He's spent those years polishing it, making the world as rich and believably weird as he can. You explore an island of puzzle mazes soaked in audio and visual clues, with Blow estimating it'll take more than 100 hours to complete.

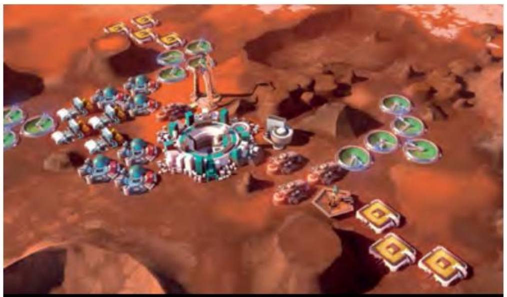
» **Publisher**: Thekla Inc » **Developer**: Thekla Inc

Star Citizen

Release date: 2016

CHRIS ROBERTS'S (YES!) SPIRITUAL SEQUEL to *Wing Commander* is a hugely ambitious, publicly funded endeavor, encompassing several game modes—first-person space combat, mining, trading, a first-person shooter campaign—all set in a multiplayer universe. With an all-star cast including Mark Hamill, Gary Oldman, and Gillian Anderson, it's going to be huge.

» **Publisher**: Cloud Imperium » **Developer**: Cloud Imperium



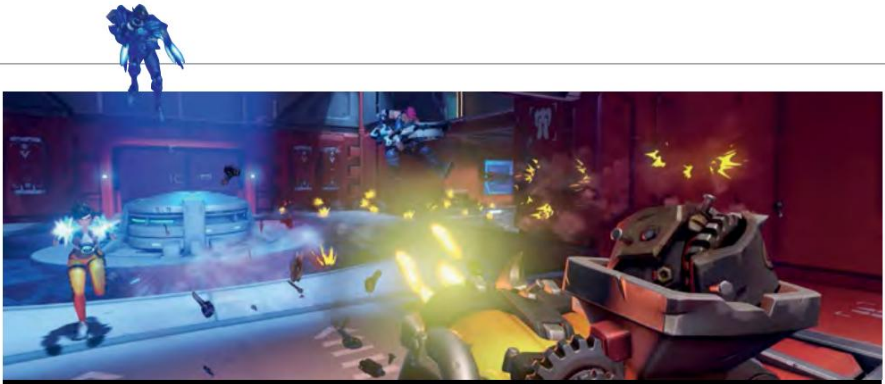
Offworld Trading Company

Release date: 2016

A MARS-BASED RTS where money is your weapon. Stake your claim to resources, extract them, and develop them into goods.

» **Publisher**: Stardock Entertainment

» **Developer**: Mohawk Games



Overwatch

Release date: 2016

ANOTHER MULTIPLAYER FPS, this time from Blizzard, leaping on the team arena shooter bandwagon with a fixed, desperate smile. It takes that Blizzard special sauce—co-operative team combat, with unbalanced heroes, and bright, shiny graphics—and mixes it with an FPS. Incidentally, the models and theme of this game are all that's left of Blizzard's long-awaited multimillion dollar *World of Warcraft* follow-up MMO *Titan*. Sad.

» **Publisher**: Activision » **Developer**: Blizzard

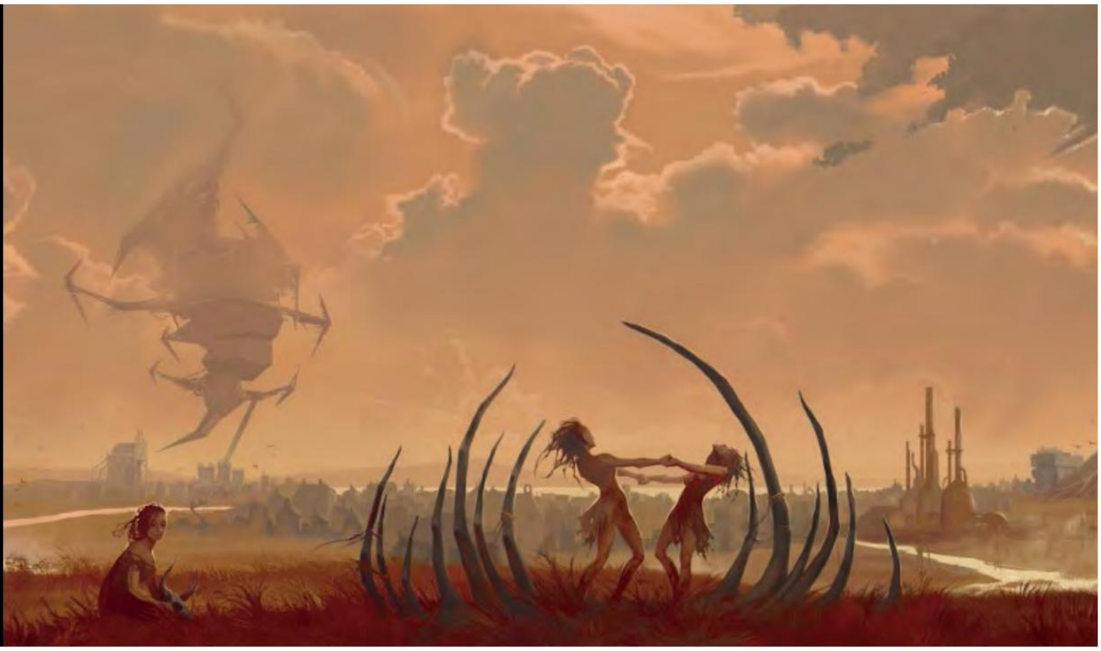
Pathologic (remake)

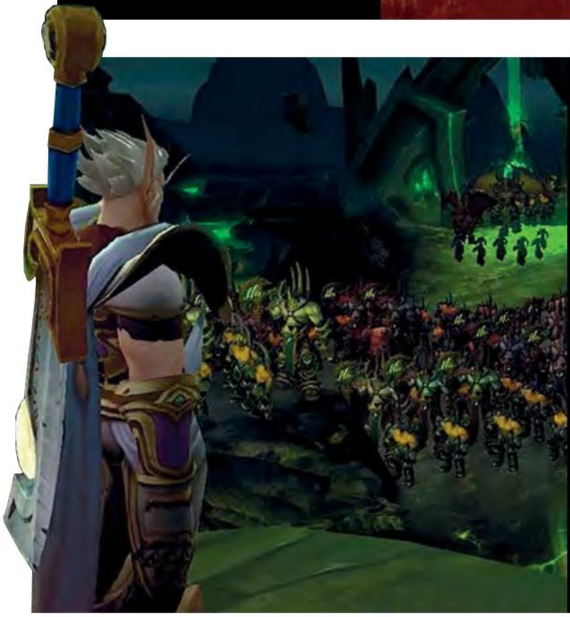
Release date: 2016

THE GRIMLY-NAMED Ice Pick Lodge has worked on four weird games since 2002, but nothing surpasses the weird, half-translated theatricality of *Pathologic* (2006). Ten years later, they're releasing an HD remake. The game follows a disease that's afflicting a strange border town. Choosing from three characters, you and key people must survive for 12 days, as the town falls apart.

» **Publisher**: Ice Pick Lodge

» **Developer**: Ice Pick Lodge





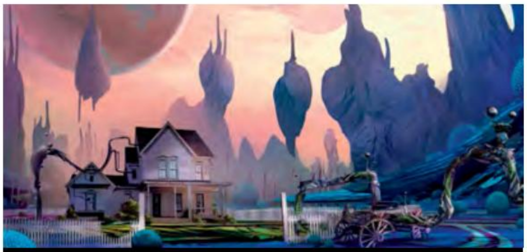
World of Warcraft: Legion

Release date: Sept 21, 2016

IT'S STILL GOING! Someone's still playing this game 11 years later (and not just our editor). Apparently, the tombs of Sargeras have been opened and the Burning Legion demons are pouring into Azeroth. Which means you get a new class, the Demon Hunter, a new area to explore, the Broken Isles, mythic weapons, class halls, and a new level cap of 110.

» **Publisher**: Activision

» **Developer**: Blizzard



Obduction

Release date: Summer 2016

THE WITNESS MIGHT be the spiritual heir to *Myst*, but *Obduction* is its literal heir, developed by the same people, including original creator Rand Miller. Like *Myst*, you are abducted to a new alien world, and challenged to puzzle out its mysteries. It's going to be built in *Unreal 4*, so it should be beautiful, too.

» **Publisher**: Cyan Worlds

» **Developer**: Cyan Worlds

The Banner Saga 2

Release date: Early 2016

THE FIRST *BANNER SAGA* was a lovely thing—the story of a caravan of Vikings and giants, fleeing an unheard-of apocalypse through the frozen wastes, attempting to reach the coast, and escape from the inhuman Dredge. This sequel retains the hard choices and tactical combat, but introduces a new race, the Horseborn, and new characters to join your handful of survivors.

» **Publisher**: Versus Evil
» **Developer**: Stoic

Torment: Tides of Numenera

Release date: 2016

THE SPIRITUAL SEQUEL to *Planescape: Torment* will finally arrive this year, boasting the legendary complexity, otherworldly art, and smart dialogue that make the original still one of the best games around. Set in the *Numenera* roleplay setting, it takes place in the medieval future of Earth, after the rise and fall of many civilizations.

» **Publisher**: InXile Entertainment
» **Developer**: InXile Entertainment

WELCOME TO THE TRACKMANIA
BLACK SERIES
HARD TO MASTER

Trackmania Turbo

Release date: Early 2016

NADEO'S ARCADE RACING construct-'em-up is certainly unique, so it's good to see a new version of it coming. Focusing on speed and stunts, this version has over 200 tracks, an improved track editor that includes random tracks, and a systemic music function that matches the music to the current track.

» **Publisher**: Ubisoft
» **Developer**: Nadeo

Factorio

Release date: 2016

BUILDING GAMES have been mostly abandoned by the big publishers, but games like *Infinifactory* have shown that indies have what it takes to keep the genre going. *Factorio* is even more lo-fi than that. You're just building and maintaining huge factories, to produce what you need and keep them safe from enemy creatures. But on an insanely complex scale.

» **Publisher**: Wube Software
» **Developer**: Wube Software

Dragon's Dogma: Dark Arisen

Release date: January 2016

DRAGON'S DOGMA was a weird, smart, fantasy console exclusive, partway between *The Legend of Zelda, Shadow of the Colossus,* and *Dark Souls.* Giant roaming monsters, such as hydras, ogres, and dragons, plague the open world, and the player is a hero volunteering to sort out the problem. This updated PC version looks better and comes with all-new content.

» **Publisher:** Capcom
» **Developer:** Capcom

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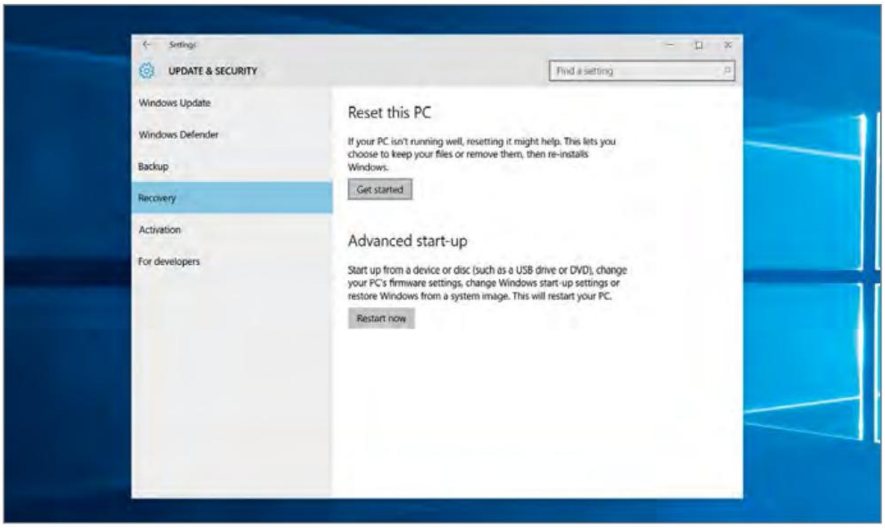
HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

WINDOWS TIP OF THE MONTH



Reset this PC

If your PC isn't running well, resetting it might help. This lets you choose to keep your files or remove them, then re-installs Windows.

Advanced start-up

Start up from a device or disc (such as a USB drive or DVD), change your PC's firmware settings, change Windows start-up settings or restore Windows from a system image. This will restart your PC.

GET RID OF THE PRE-WINDOWS 10 GARBAGE

Fear the horrors that come with upgrading to Microsoft's latest endeavor? We have a solution. First, upgrade to Windows 10 using Microsoft's default installer. Then go to "Start," click "Settings," head to "Update & security," select "Recovery," then hit "Get started" under "Reset this PC." Then select "Remove everything" and this cleans your drive, wiping all your old files, OSes and programs that might cause problems.

MAKE – USE – CREATE

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Build a NAS with a Raspberry Pi 2

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Stitch photos with Photoshop

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Make a poor man's NAS with FreeNAS

ZAK STOREY
STAFF WRITER

COMMAND PROMPT COPY AND PASTE

I get it—not everyone uses the command prompt. And I'll be honest, it's not the most exciting thing to talk about either. That said, if you're in the habit of benchmarking using X264, or perhaps you're just a Linux convert missing the familiarity of home, the command prompt is an incredibly useful tool to get to grips with. And fortunately for us all, Windows 10 made one major improvement here. It all revolves around a pivotal action in the Windows operating system that's been around for as long as the floppy disk has been the icon for "Save."

We're talking about copy and paste. Yep, after almost 30 years of Microsoft releasing "new and improved" versions of the Windows operating system, the company has finally got around to adding copy and paste to the command prompt. Although a simple feature, the fact it's taken this long to add it to the faithful old black box makes it nigh-on incredible.

You use it almost exactly as you would in any other program. Copy your text or code from your original document or source, then head to the command prompt, right-click that lovely little black window, and hit "Paste." One thing to note: If you try doing this with the key shortcuts you're used to, it's just not going to fly. The command prompt doesn't recognize Ctrl-V or Ctrl-C.

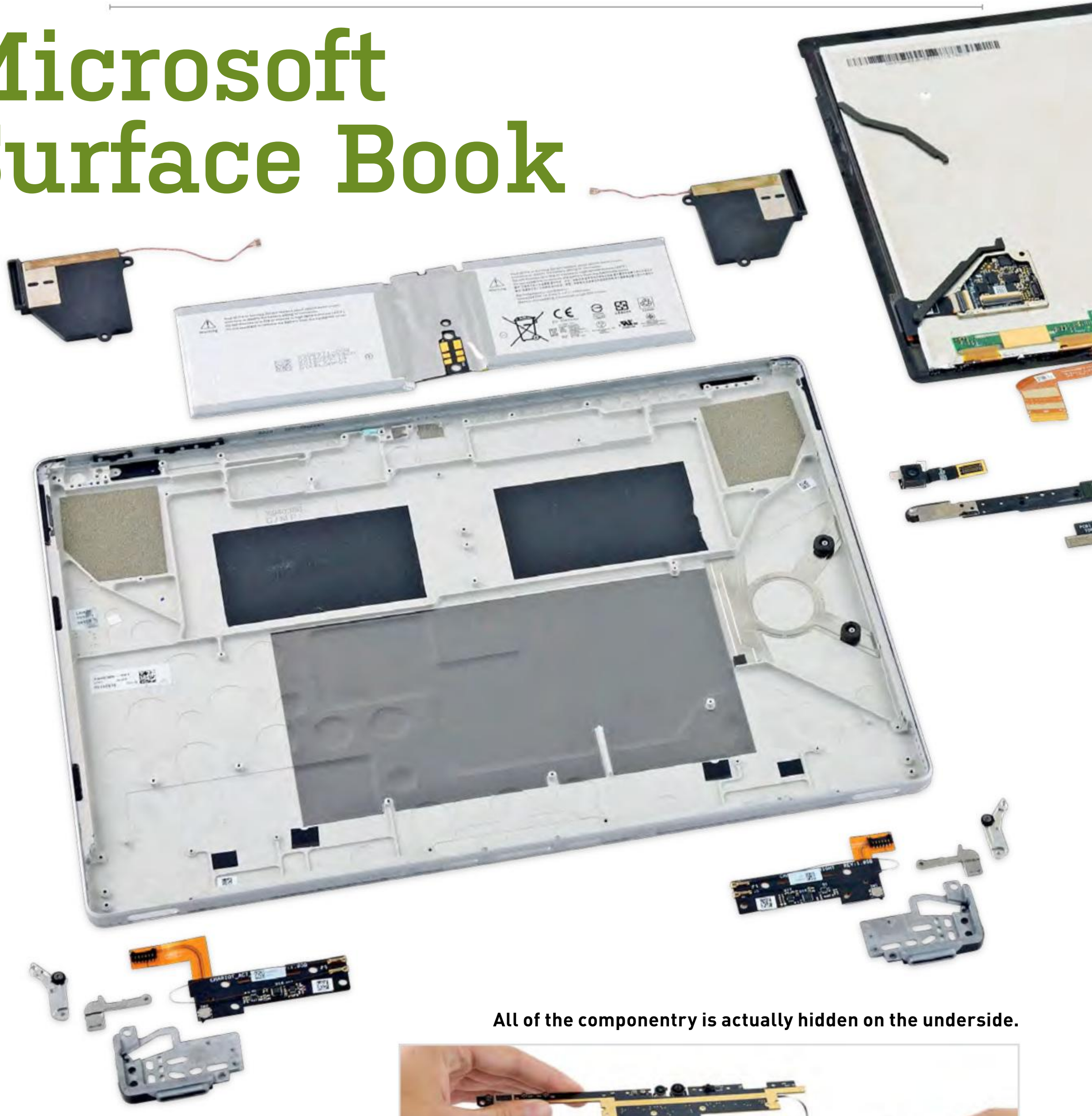
↘ submit your How To project idea to: comments@maximumpc.com

IFIXIT presents:

AUTOPSY

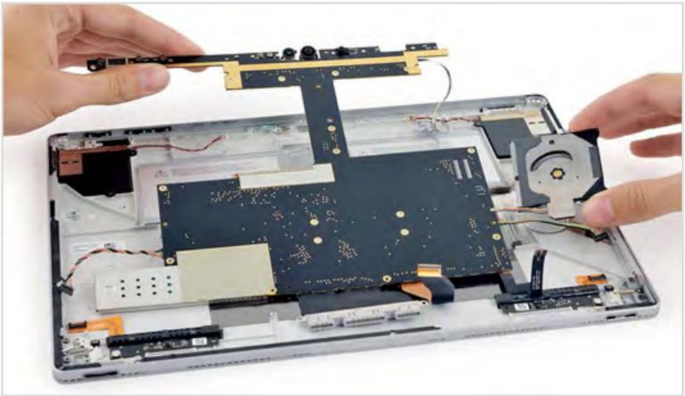
THIS MONTH WE DISSECT...

Microsoft Surface Book



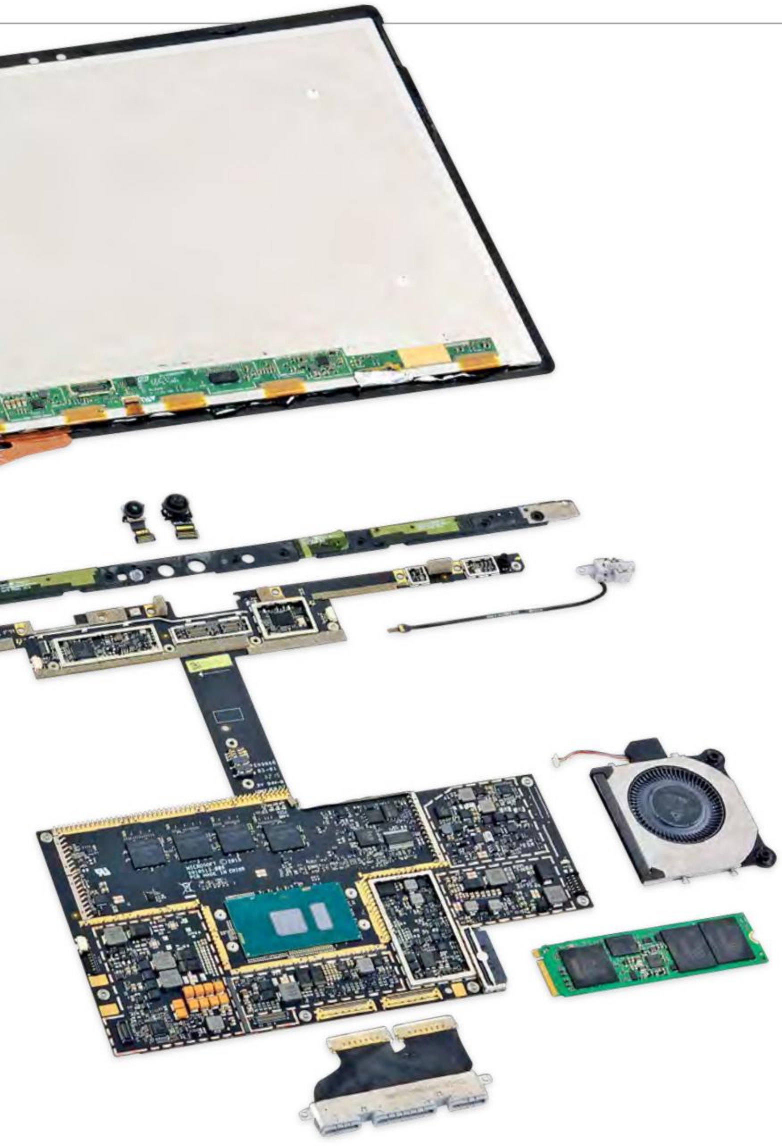
The Surface Book—so big we only have room for the main unit.

All of the componentry is actually hidden on the underside.



About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.



The keyboard looks suspiciously like a MacBook.

BACKGROUND:

We've got the Surface Book, a laptop to replace the tablet that replaced your laptop. It's the first ever notebook from Microsoft, and with its detachable display and pressure-sensitive Surface Pen, it defies categorization—but not teardownification. Join us as we dismantle the Surface Book!

MAJOR TECH SPECS:

- 13.5-inch PixelSense multitouch display, with 3000x2000 resolution (267ppi)
- Sixth-gen Intel Core i5 with dedicated Nvidia GPU
- 8GB RAM
- 128GB solid-state drive
- 802.11ac Wi-Fi and Bluetooth 4.0
- 8MP rear camera with 1080p video, and 5MP front camera
- Surface Pen with 1,024 levels of pressure sensitivity

KEY FINDINGS:

- We know our way past this display. It may be bigger (and seemingly more flexible) than we saw in the Surface Pro 4, but it opens with the same password: iOpener. Experience doesn't make it any less nerve-wracking. The Surface line has come a long way, but we'd love to see an upgrade to its opening procedure. Something that doesn't threaten to send glass shards flying at the slightest misstep....
- Peeling up a thin foam layer confirms that the motherboard is upside-down. Smooth on the top, connectors and chips on the bottom. Surprisingly, the mobo sprawls throughout the entire chassis, resembling a nightmarish *Tetris* piece.
- While the rear camera comes free without a fight, the rest of the sensor array is stuck. The front-facing camera and IR sensor are glued to the chassis, and trapped beneath the motherboard assembly, which makes for some tricky prying.
- The lower case sits smooth and flush, with a very thin gap. We know what that means—time to warm the iOpener back up and get ready to pry. After some intense heating and arduous prying, we finally get past the hefty adhesive.
- With the power disconnected, let's get a closer look at this, the real power behind the Surface Book. With 51W (6,800mAh at 7.5V), the base battery provides nearly three times the juice as the tablet. Both batteries combined give us 69W, just a mite shy of the 74.9W you'd get in this year's 13-inch Retina MacBook Pro.
- The Microsoft Surface Book (as a whole) earns a repairability score of 1 out of 10 (10 is easiest to repair). After the difficult opening procedure, the SSD can be replaced. So too the glued battery in the display. However, the base battery is very heavily glued. The processor and RAM are soldered to the motherboard. Strong adhesive holds many components in place, including the display, base cover, and batteries.

Build a NAS with a Raspberry Pi 2

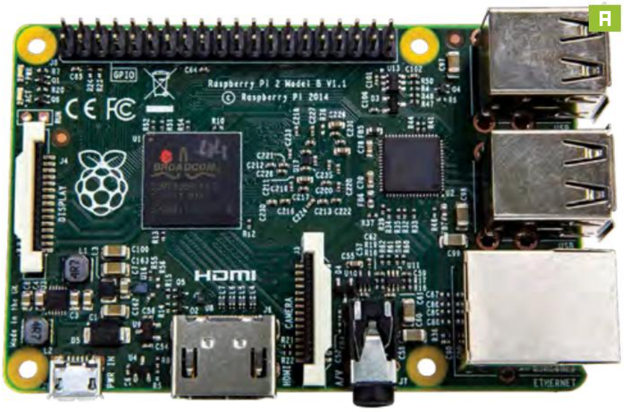
YOU'LL NEED THIS

RASPBERRY Pi 2
The brilliant mini-computer costs under $45. See www.raspberrypi.org.

OPENMEDIAVAULT
Download it from www.openmediavault.org.

DO YOU HAVE A BUNCH OF USB DISKS that you juggle between your various computers? Did you know that you can plug all of them into a Raspberry Pi 2, which you can then use as a network attached storage (NAS) box? Using the Pi as an always-on NAS box sounds like a wonderful use of the silent little device. However, setting it up as one used to be an involved process. That's until the Debian-based OpenMediaVault (OMV) distro decided to roll out a version specifically tuned to the little, power-efficient Raspberry Pi 2.

Once it's up and running, you can configure and manage the distro using its browser-based administration interface. You can then use the USB ports on the Pi to attach USB disks, which are made available to your entire network for storage. Remember that for best performance, you need to make sure you use self-powered removable disks. You can use the disks attached to the OMV NAS individually, or assemble them in a software RAID array. The distro has ample options to manage other advanced aspects of a NAS distro. **–MAYANK SHARMA**



1 GRAB OPENMEDIAVAULT

To get started, download the Pi version from the distro's website at www.openmediavault.org. The distro has separate releases for the Pi 2 [Image A] and the original B/B+ models, so ensure you grab the correct one. Then extract the .img file from the download and transfer it on to an SD card with:

```
sudo dd if=~/omv_1.17_rpi_rpi2.img  of=/dev/sdb
```

replacing "/dev/sdb" with the location of your SD card. If you use Windows, use the Win32 Disk Imager app to transfer the image across.

›› Now boot the Pi with the freshly-baked SD card. There's no installation involved, and you can start configuring the distro as soon as it boots up. You can access its browser-based interface on the IP address of the Pi—such as 192.168.3.111. You'll need to authenticate yourself, which you can do using the default credentials for the administrator—admin:openmediavault. However, you should change this default as soon as you log in. Head to "System → General Settings" in the navigation bar on the left, switch to the "Web Administrator Password" tab, and enter the new password in the appropriate text boxes. You can also use the "System" menu to configure several aspects of the NAS server, such as the server's date and time, enable plugins (see "Extend your NAS" below), and keep the system updated.

2 ADD YOUR USB DISKS

Once it's up and running, plug one or multiple USB disks into the Raspberry Pi. Head to "Storage → Physical Disks" and click the "Scan" button to make OMV

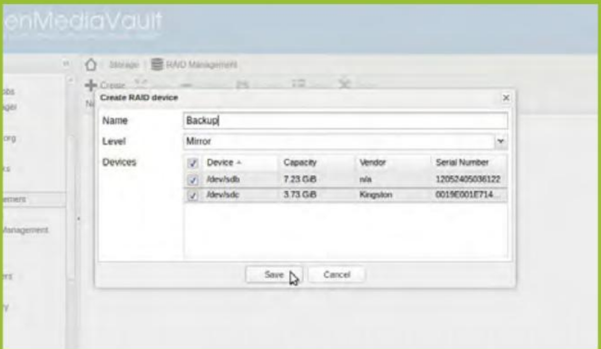
EXTEND YOUR NAS

You can flesh out OMV and add a bunch of features to make it more usable. It supports quite a lot of official and third-party plugins. To browse a list of all the officially supported plugins, head to "System → Plugins." The page lists over 40, which are divided into categories such as Administration, Backup, Downloaders, Filesystems, Network, and so on. One useful plugin is the downloader plugin, which can download files straight to the NAS, and includes several downloaders such as Aria2 and Youtube-DL. This is well complemented by the transmission plugin, which downloads torrents via the Transmission app. You should also enable the clamav plugin, which gives you the ability to scan your NAS for viruses.

To enable a plugin, simply click the corresponding checkbox. You can even toggle multiple plugins at one go. After selecting the plugins you wish to enable, click "Install." OMV then downloads the plugins from the Raspbian repositories via the apt-get package management system, and enables you to track its progress. Depending on the number of plugins and their size, this process could take some time to complete.

Once the plugins have been downloaded and installed, they append the OMV administration interface, and create an entry for themselves. For example, the downloader plugin installs itself under "Server → Downloader." Switch to the new section when you want to configure different aspects of the plugin. Each plugin has its own configurable elements.

SET UP A RAID


OpenMediaVault
Storage
RAID Management
Create
Save
Cancel

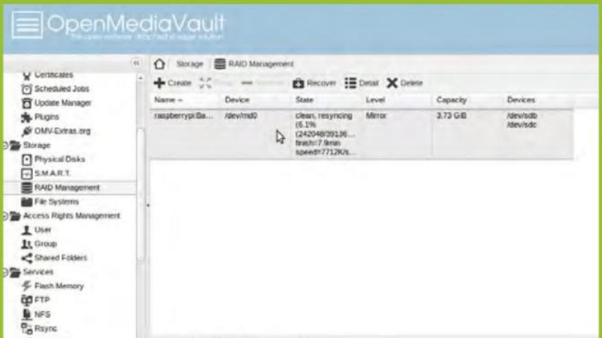
Create RAID device

Name: Backup
Level: Mirror
Devices:

☑	Device	Capacity	Vendor	Serial Number
☑	/dev/sdb	7.23 GiB	n/a	12052405036122
☑	/dev/sdc	3.73 GiB	Kingston	0019E001E714...

1. SELECT RAID LEVEL

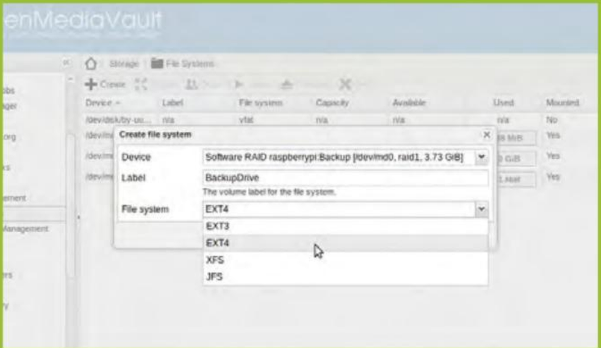
If you wish to arrange the disks into a RAID device, head to "Storage → RAID Management" and click "Create." In the dialog box, select the devices you want to use in the RAID, as well as the RAID level. Then enter the name you wish to use for the RAID device in the space provided, and click "Save."


OpenMediaVault
Certificates
Scheduled Jobs
Update Manager
Plugins
OMV-Extras.org
Storage
Physical Disks
S.M.A.R.T.
RAID Management
File Systems
Access Rights Management
User
Group
Shared Folders
Services
Flash Memory
FTP
NFS
Rsync
SMB/CIFS
Create
Recover
Detail
Delete
Page 1 of 1

Name	Device	State	Level	Capacity	Devices
raspberrypi:Ba...	/dev/md0	clean, resyncing (6.1% (242048/39136... finish=7.9min speed=7712K/s...	Mirror	3.73 GiB	/dev/sdb /dev/sdc

2. INITIALIZE THE RAID

After you've created a RAID, OMV asks you to wait until the RAID has been initialized before you proceed to the next step and create a filesystem. You also get a notification to save the changes in order for them to take effect. The RAID Management page now lists the newly-created RAID device.

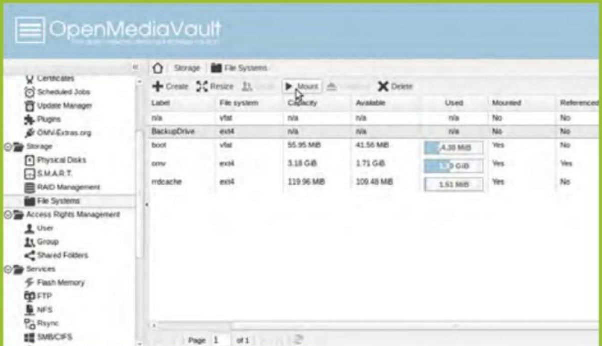

OpenMediaVault
Storage
File Systems
Create
EXT3
EXT4
XFS
JFS

Create file system

Device: Software RAID raspberrypi:Backup [/dev/md0, raid1, 3.73 GiB]
Label: BackupDrive
The volume label for the file system.
File system: EXT4

3. CREATE A FILESYSTEM

To use the RAID array, you need to create a filesystem. Head to "Storage → Filesystems," and click "Create." In the dialog box, select the device you want to format using the pull-down menu, which lists the RAID device you've just created. Then label it, and select one of the supported filesystems.


OpenMediaVault
Certificates
Scheduled Jobs
Update Manager
Plugins
OMV-Extras.org
Storage
Physical Disks
S.M.A.R.T.
RAID Management
File Systems
Access Rights Management
User
Group
Shared Folders
Services
Flash Memory
FTP
NFS
Rsync
SMB/CIFS
Create
Resize
Mount
Delete
Page 1 of 1

Label	File system	Capacity	Available	Used	Mounted	Referenced
n/a	vfat	n/a	n/a	n/a	No	No
BackupDrive	ext4	n/a	n/a	n/a	No	No
boot	vfat	55.95 MiB	41.56 MiB	4.38 MiB	Yes	No
omv	ext4	3.18 GiB	1.71 GiB	[illegible] GiB	Yes	Yes
rrdcache	ext4	119.96 MiB	109.48 MiB	1.51 MiB	Yes	No

4. MOUNT THE DEVICE

After the filesystem has been created, and the disk has been initialized, the RAID device is listed with other devices in the "Storage → Filesystems" page. To use the drive, select it, then click "Mount" to bring it online. You can add new disks by selecting the "Storage → RAID Management → Grow" option.

aware of the USB disks. Then use the "Wipe" button to clean the disks individually. If you've inserted multiple disks, OMV can even tie them into a software RAID [**Image B**]. OMV supports multiple RAID levels, and each requires a different number of disks. For example, the default RAID level 5 requires a minimum of three disks, while RAID 1, which mirrors data across drives, only needs a minimum of two.

3 PREPARE THE DISKS

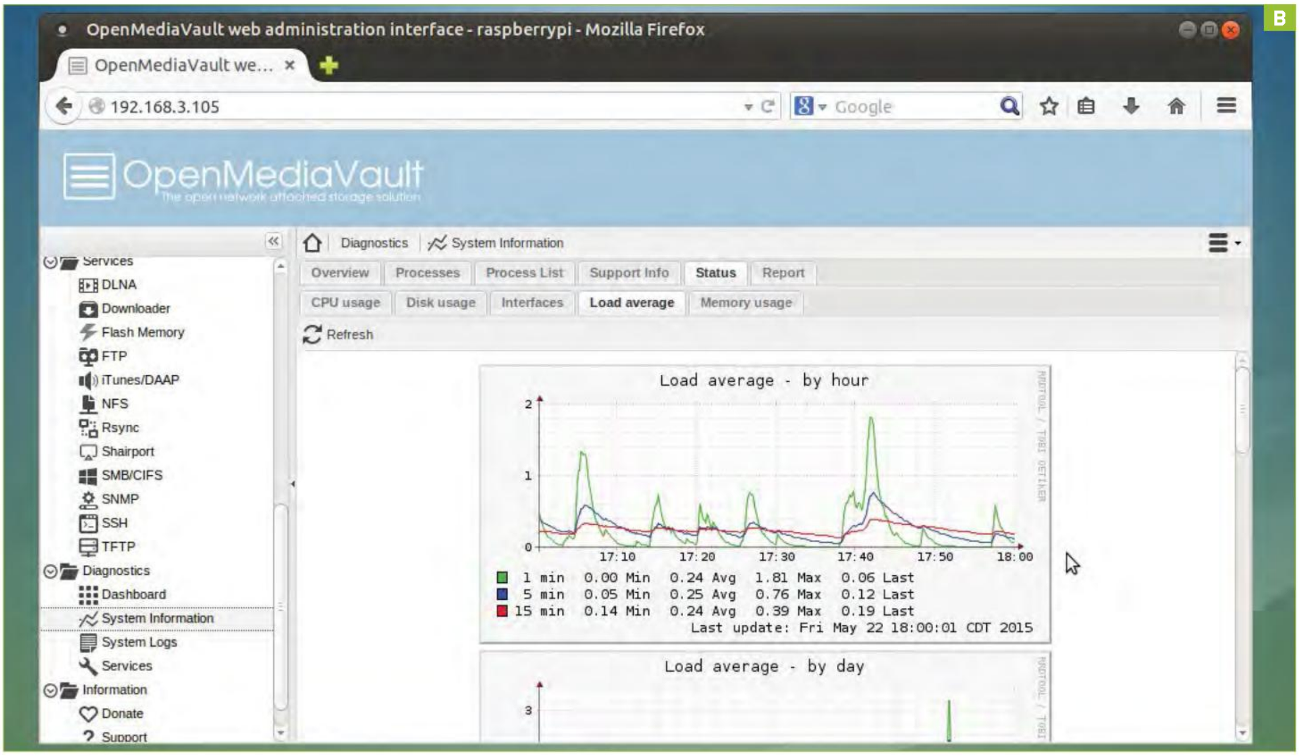
If you don't plan to use the inserted USB disk inside a RAID array, after you've erased a drive, head to "Storage → File Systems" to create a filesystem on the drive. Here, click the "Create" button and use the pull-down menu to select the device you wish to format. By default, the drives are formatted as EXT4 but you can select a different filesystem using the pull-down menu. Besides EXT4, OMV supports the EXT3, XFS, and JFS filesystems. Repeat the process to create a filesystem on all of the attached USB disks. After creating the filesystem, select a drive, then click the "Mount" button to bring it online.

Before you can store data on the NAS device, you have to create one or more users. To do this, head to "Access Rights Management → User." The "Add" button on this page is a pull-down menu that enables you to either add individual users or import a bunch of users by adding them in the specified format. When adding an individual user, you can also add them to an existing group. By default, all users are added to the Users group.

›› If you wish users to have their own home directories in the OMV server, switch to the "Settings" tab and mark the checkbox to enable the home directory for the user. You also have to specify the location for the home directory by selecting an existing shared folder on the NAS server, or by creating a new one.

4 SET UP A SHARED FOLDER

The next step is to define a shared folder. The chief consideration when adding one is whether the NAS will be used by multiple users or a single individual. In case


B
OpenMediaVault web administration interface - raspberrypi - Mozilla Firefox
OpenMediaVault we...
192.168.3.105
Google
OpenMediaVault
The open network attached storage solution
Services
DLNA
Downloader
Flash Memory
FTP
iTunes/DAAP
NFS
Rsync
Shairport
SMB/CIFS
SNMP
SSH
TFTP
Diagnostics
Dashboard
System Information
System Logs
Services
Information
Donate
Support
Diagnostics
System Information
Overview
Processes
Process List
Support Info
Status
Report
CPU usage
Disk usage
Interfaces
Load average
Memory usage
Refresh
Load average - by hour
2
1
0
17:10
17:20
17:30
17:40
17:50
18:00
RRDTOOL / TOBI OETIKER
Load average - by day
3

```
1 min   0.00 Min  0.24 Avg  1.81 Max  0.06 Last
5 min   0.05 Min  0.25 Avg  0.76 Max  0.12 Last
15 min  0.14 Min  0.24 Avg  0.39 Max  0.19 Last
              Last update: Fri May 22 18:00:01 CDT 2015
```

you're going to be sharing the NAS storage space with multiple users, you can define several folders, each one with different user permissions. To add a folder, head to "Access Rights Management → Shared Folders," and click the "Add" button. In the dialog box that pops up, select the volume that will house the folder from the pull-down list. Then give the shared folder a name, such as "Backup," and enter the path of the folder you wish to share, such as "backup/." OMV creates the folder if it doesn't already exist. You can also optionally add a comment to describe the type of content the folder will hold. Pay close attention to the Permissions setting. By default, OMV only allows the administrator and any users you've added to read and write data to this folder, while others can only read its contents. This is a pretty safe default for most installations, but the distro also offers several permutations and combinations of permissions that you can select by using the pull-down menu.

ANOTHER PI TUTORIAL NEXT MONTH

5 TWEAK ACCESS PERMISSIONS

Even if you select the default Permissions setting when creating folders, which lets all users read and write data to the folder, you can fine-tune the access permissions, and disable certain users from accessing or modifying the contents of a particular folder. For this, after adding a user, head to the "Shared Folders" section, select the folder you want to control access to, and click the "Privileges" button. This opens a window with a list of the users you have added, along with checkboxes for controlling their access to that folder.

›› With the users and shared folders set up, you're now ready to share the NAS storage with your network. Follow the walkthrough opposite to enable a network service that people can use to access the shared folders on the NAS [**Image C**]. OMV supports various popular protocols and services, including NFS, SMB/CIFS, FTP, TFTP, SSH, rsync, and more.

6 ACCESS YOUR NAS

Once you have created a network share, you can access the shared folders from anywhere on the network, irrespective of whether they reside on

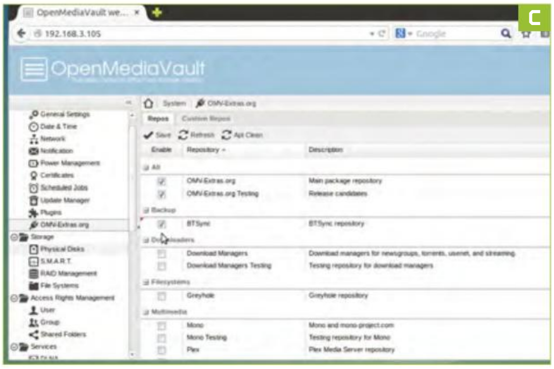
STREAM MUSIC

If you've stored music on the NAS, wouldn't it be cool if you could stream it across the network straight from the NAS? Using the forked-daapd plugin, you can do just that. Install it like any other plugin—this adds a new entry under "Services," labeled "iTunes/DAAP."

Before you can stream music, you need to configure the plugin by pointing it at the shared folder on the NAS that contains the music files. Head to the plugin's page, and use the "Shared folder" drop-down menu to select the folder that houses the music. Once you've saved the changes, use a player such as Rhythmbox, Amarok, Banshee, and so on, which will automatically pick up the DAAP server running on your NAS, and enable you to listen to the tracks on the NAS. Use the DAAP Media Player app to listen to the music on an Android device. Furthermore, you can also install the MiniDLNA plugin to connect to your NAS from DLNA clients. Just as with DAAP, after installing the MiniDLNA plugin, you have to head to "Services → DLNA → Shares," and click "Add" to point to the shared folder that contains the music. You can then use the BubbleUPnP app to convert your Android phone into a DLNA-compatible device, so that it can browse the library and stream music to and from your now-DLNA-compatible NAS.

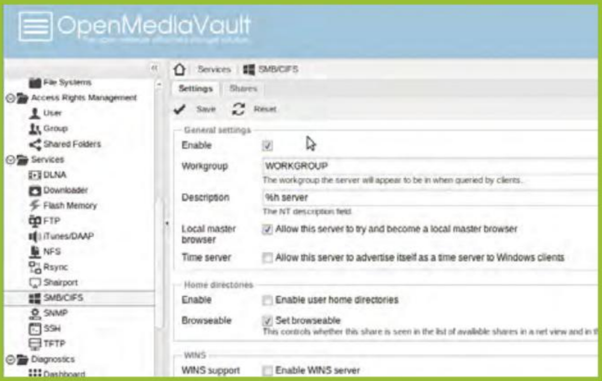
an individual disk or a RAID array. You can either use your file manager's built-in Network feature to access the network shares, or enter the IP address of the NAS device in the location area, such as "smb://192.168.3.111." You're prompted for a username and password before you can access the folders—unless, of course, you have marked them as public when adding them via Samba. Enter the credentials of the user who has the appropriate permission to access the folder. After they have been verified, OMV mounts the shared folder. You can now upload your files into the shared folder or delete them, if you have the permission, just as you can in a regular folder.

›› It might take some getting used to, but OpenMediaVault is a wonderfully versatile NAS option that helps you exploit the true potential of the Raspberry Pi. ⏻


C
OpenMediaVault we...
192.168.3.105
Google
OpenMediaVault
General Settings
Date & Time
Network
Notification
Power Management
Certificates
Scheduled Jobs
Update Manager
Plugins
OMV-Extras.org
Storage
Physical Disks
S.M.A.R.T.
RAID Management
File Systems
Access Rights Management
User
Group
Shared Folders
Services
System
OMV-Extras.org
Repos
Custom Repos
Save
Refresh
Apt Clean

Enable	Repository	Description
All		
☑	OMV-Extras.org	Main package repository
☑	OMV-Extras.org Testing	Release candidates
Backup		
☑	BTSync	BTSync repository
Downloaders		
☐	Download Managers	Download managers for newsgroups, torrents, usenet, and streaming
☐	Download Managers Testing	Testing repository for download managers
Filesystems		
☐	Greyhole	Greyhole repository
Multimedia		
☐	Mono	Mono and mono-project.com
☐	Mono Testing	Testing repository for Mono
☐	Plex	Plex Media Server repository

ENABLE SHARES


OpenMediaVault
File Systems
Access Rights Management
User
Group
Shared Folders
Services
DLNA
Downloader
Flash Memory
FTP
iTunes/DAAP
NFS
Rsync
Shairport
SMB/CIFS
SNMP
SSH
TFTP
Diagnostics
Dashboard
Services
SMB/CIFS
Settings
Shares
Save
Reset

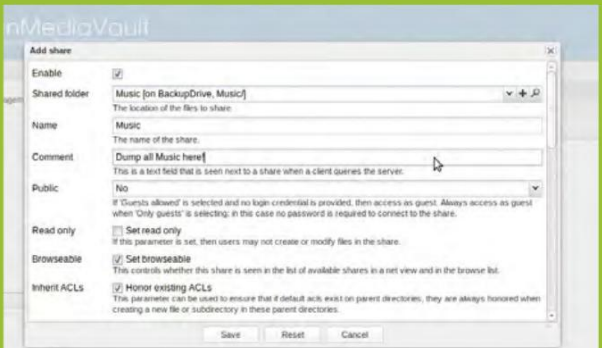
General settings
Enable ☑
Workgroup: WORKGROUP
The workgroup the server will appear to be in when queried by clients.
Description: %h server
The NT description field
Local master browser: ☑ Allow this server to try and become a local master browser
Time server: ☐ Allow this server to advertise itself as a time server to Windows clients

Home directories
Enable: ☐ Enable user home directories
Browseable: ☑ Set browseable
This controls whether this share is seen in the list of available shares in a net view and in t

WINS
WINS support: ☐ Enable WINS server

1. ENABLE SAMBA

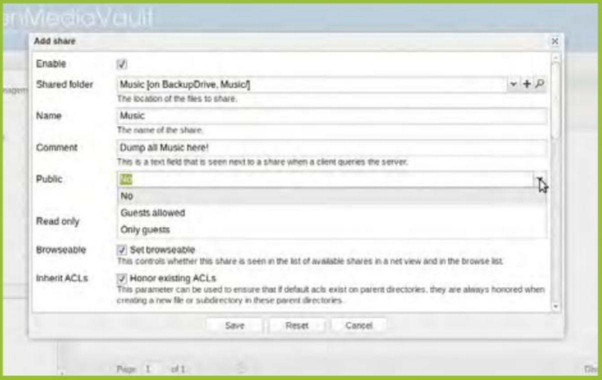
OMV supports several sharing protocols but we'll use the popular SMB protocol commonly known as Samba, which works across devices. To activate the service, head to "Services → SMB/CIFS," and toggle the "Enable" checkbox. The other settings mentioned on the page are optional. When you're done, click the "Save" button.


nMediaVault
Save
Reset
Cancel

Add share
Enable: ☑
Shared folder: Music [on BackupDrive, Music/]
The location of the files to share.
Name: Music
The name of the share.
Comment: Dump all Music here!
This is a text field that is seen next to a share when a client queries the server.
Public: No
If 'Guests allowed' is selected and no login credential is provided, then access as guest. Always access as guest when 'Only guests' is selecting; in this case no password is required to connect to the share.
Read only: ☐ Set read only
If this parameter is set, then users may not create or modify files in the share.
Browseable: ☑ Set browseable
This controls whether this share is seen in the list of available shares in a net view and in the browse list.
Inherit ACLs: ☑ Honor existing ACLs
This parameter can be used to ensure that if default acls exist on parent directories, they are always honored when creating a new file or subdirectory in these parent directories.

2. ADD FOLDERS

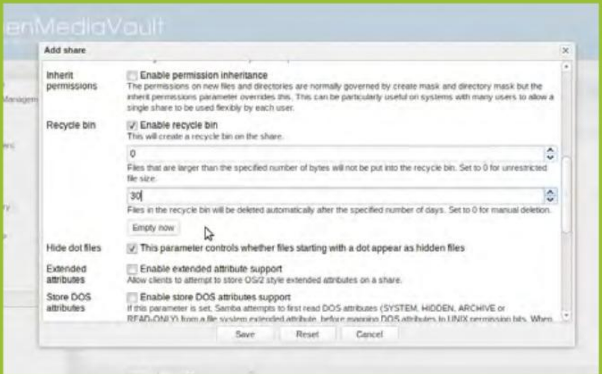
Next, you have to add the shared folders as Samba shares. To do this, switch to the "Shares" tab and click the "Add" button. In the window that pops up, select a shared folder from the pull-down list, or click the "+" button to create a new one. You also have to give the folder a name, which identifies the folder on the network.


enMediaVault
Save
Reset
Cancel
Page 1 of 1

Add share
Enable: ☑
Shared folder: Music [on BackupDrive, Music/]
The location of the files to share.
Name: Music
The name of the share.
Comment: Dump all Music here!
This is a text field that is seen next to a share when a client queries the server.
Public: No
No
Guests allowed
Only guests
Read only
Browseable: ☑ Set browseable
This controls whether this share is seen in the list of available shares in a net view and in the browse list.
Inherit ACLs: ☑ Honor existing ACLs
This parameter can be used to ensure that if default acls exist on parent directories, they are always honored when creating a new file or subdirectory in these parent directories.

3. DEFINE PERMISSIONS

When adding a Samba folder, OMV makes sure it follows the permissions defined when you created the shared folder. Select the "Guests Allowed" option from the "Public" pull-down menu to make the folders public. Also, if you select the "Set Read Only" checkbox, OMV ensures that no user can modify the contents of the folder.


enMediaVault
Empty now
Save
Reset
Cancel

Add share
Inherit permissions: ☐ Enable permission inheritance
The permissions on new files and directories are normally governed by create mask and directory mask but the inherit permissions parameter overrides this. This can be particularly useful on systems with many users to allow a single share to be used flexibly by each user.
Recycle bin: ☑ Enable recycle bin
This will create a recycle bin on the share.
0
Files that are larger than the specified number of bytes will not be put into the recycle bin. Set to 0 for unrestricted file size.
30
Files in the recycle bin will be deleted automatically after the specified number of days. Set to 0 for manual deletion.
Hide dot files: ☑ This parameter controls whether files starting with a dot appear as hidden files
Extended attributes: ☐ Enable extended attribute support
Allow clients to attempt to store OS/2 style extended attributes on a share.
Store DOS attributes: ☐ Enable store DOS attributes support
If this parameter is set, Samba attempts to first read DOS attributes (SYSTEM, HIDDEN, ARCHIVE or

4. OTHER SETTINGS

Take some time to review the other settings on the page. One useful option that isn't enabled by default is the Recycle Bin. When enabled, any file that's deleted from the NAS is moved into a virtual Recycle Bin inside the shared folder. Save the configuration when you have added them all to restart the Samba service.

Cool Animated Wallpapers for All!

YOU'LL NEED THIS

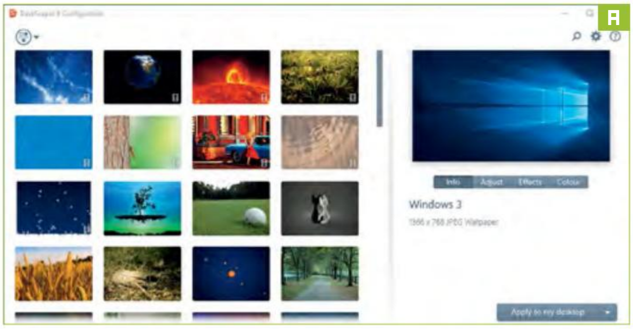
WINDOWS 10
There are solutions for other versions of Windows.

DESKSCAPES
Download it from www.stardock.com/products/deskscapes/.

FINDING THE PERFECT WALLPAPER is a nightmare for even the most eagle-eyed of hunters. If you're used to looking around sites such as Wallhaven or Wallpaperswa, there's a pretty high likelihood that you're simply not going to find the perfect desktop image for your idling woes.

What we're about to teach you will alleviate that frustration. It's hardly a new technique though. In fact, you'll probably remember this kind of technique from awful advertisements in pop-up ads back in the nineties and noughties. We're talking about animated desktop wallpapers. This is connected to the recent trend of reinvigorate how we look at websites—a good example being Blizzard and its latest expansion sites. These usually feature a constantly-looping background image or wallpaper, providing a stunning design portent on an otherwise recurring webpage.

By using a small piece of software called DeskScapes, it's possible to take these looping videos and employ them as your desktop wallpapers. If you're not a fan of the Blizzard franchises, you can easily jump ship and find some other video to satisfy your animated wallpaper needs. **–ZAK STOREY**



1 DOWNLOAD DESKSCAPES

The first thing you're going to want to do is get a copy of DeskScapes. You may have heard of the company behind this marvelous piece of software before—Stardock. This is the same company that provided many of us on Windows 8 with an alternative to the abysmally unpleasant Start menu found in that operating system. Go to www.stardock.com/products/deskscapes/ and hit "Get It Now." You can either pay for the full package—coming in at a reasonable $9.99 for life—or just opt for the trial version, to see whether you like it. Then hit "Try it now," and download the installer—don't worry, it's free from malware and bloatware.

2 INSTALL DESKSCAPES

Next, you'll want to install DeskScapes. It's a pretty simple process—you're asked whether or not you'd like to activate it here. You need to enter your email address, and then verify it with the corresponding email you're sent. Once that's done, you're almost all set. Now open up DeskScapes and take a little look around [**Image A**]. You'll find some pretty bland default basic wallpapers, and even a couple of animated ones, although they are nowhere near as exciting as some of the other options to be found online.

3 GRAB A NEW ANIMATED WALLPAPER

At this point, you've got two options: You can either click the link at the bottom of the DeskScapes application, or hunt for your own wallpapers. Our suggestion is to do a little of both. If you do head over to www.wincustomize.com, you'll have to bear in mind that the website itself is fairly old, and in a state of disrepair. The highest quality content you'll find is 1080p, even if it's labeled as 4K. Additionally, you're limited to three or four individual downloads of animated wallpapers, and no more than that without subscribing. There are ways around this if you think about it for long enough—but that's entirely at your discretion.

4 RIP A LOOPING IMAGE FROM THE WEB

If you're after something a little more glamorous, you're going to want to find a looping video background. Blizzard's a good place to start for these [**Image B**], but there are plenty more littered around the web. In Chrome, right-click the looping video you've found, and select "Inspect Element." Once the big, old source code bar opens up, hit F3 and search for the term "loop." This should take you to the first looping video (if there is one, and it isn't some Java trickery). Click the drop-down menu and it should provide you with two links: one to a .webm file, and another to a .mp4 file. Double-click either of the two links, copy it, and then paste it into a new window.

5 CONVERT YOUR VIDEO

Now you need to right-click and hit "Save video as." Save it somewhere you'll remember—generally speaking, we like to use the desktop for this—and then you'll be good to go. Next, you'll want to change the video file

B
WORLD WARCRAFT
LEGION
LET THE HUNT BEGIN

into something DeskScapes can use. For this, you need to convert the file over from the MP4 format to AVI. You can use all manner of online converters, but most of the time you'll find they reduce the overall quality of the video, meaning worse quality backgrounds for your new desktops, annoyingly. Your best bet is to use software such as Adobe's Premiere Pro, Sony Vegas or Handbrake (if you want to go down the free route) to convert it to an AVI file.

6

ADD FILES INTO DESKSCAPES

Next, you need to add your new beauty to DeskScapes. To do this, open up the DeskScapes application and hit the funny-looking three-squares button in the top-left corner. Move your mouse down to the "Folders" subsection, then from that submenu scroll all the way to the bottom and hit "Add/remove folders." Now click "Add," and create a new folder—we suggest making it in your Pictures directory. Hit "Yes" to skip past the root drive warning, and then you're done. Move your freshly converted AVI file into the folder, and close down DeskScapes. Now you're ready to make the magic happen.

7

ACTIVATE THE ANIMATED WALLPAPER

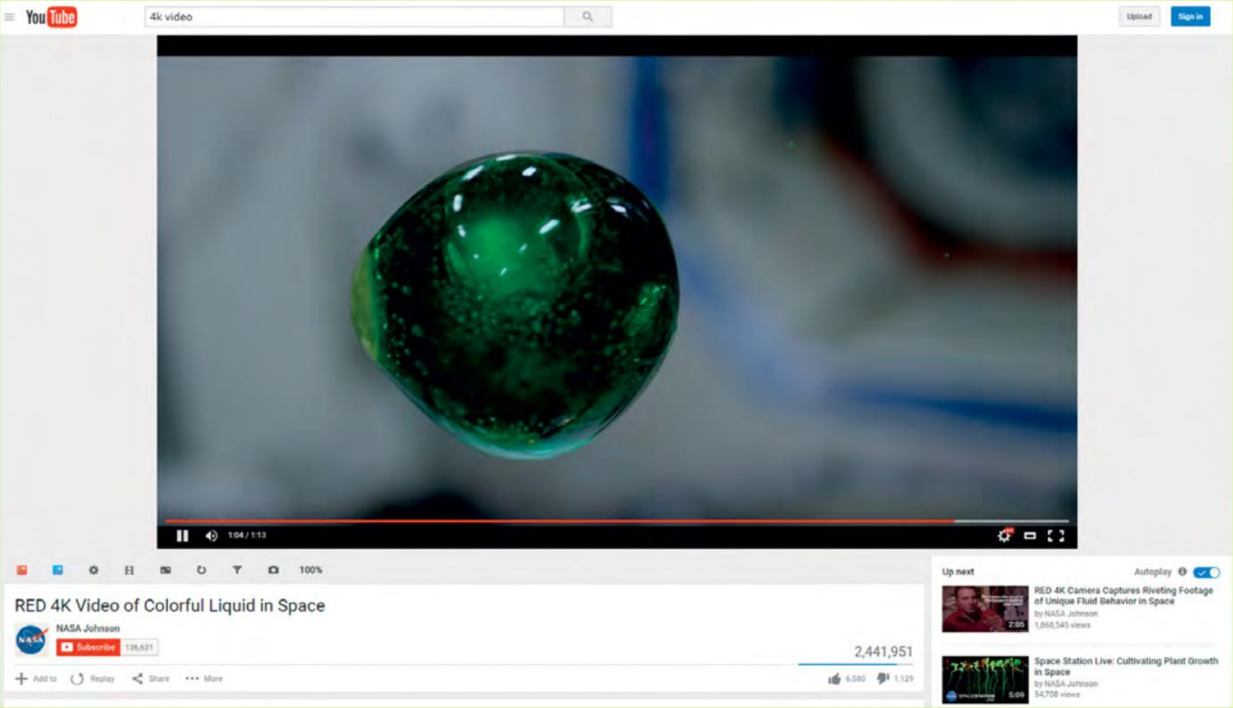
Open up DeskScapes once again—now it's just a case of finding your new animated wallpaper. Scroll down to the bottom of the list, and you should find your animated wallpaper there—select it. At this point, you can either hit "Apply to my desktop" directly or select the drop-down arrow on the right. Here you can either set it as your current desktop wallpaper, or set it to run as your screensaver [**Image C**].

8

WHAT ABOUT THE BASICS?

DeskScapes still has you covered if you just fancy using standard wallpapers, too. If you hold down Ctrl, you can select multiple wallpapers to use at any given time, or use them separately as rotating screensavers. On top of that, if you want, you can adjust the images using DeskScapes' integrated photo editor—it's far more basic than the likes of Adobe Photoshop or other available photo-editing software, but you can do some moderately interesting things with it. ⏻

WHAT ABOUT THE PERFORMANCE HIT?


YouTube
4k video
Upload
Sign in
1:04 / 1:13
100%
RED 4K Video of Colorful Liquid in Space
NASA Johnson
Subscribe
136,631
2,441,951
Add to
Replay
Share
More
6,580
1,129
Up next
Autoplay
RED 4K Camera Captures Riveting Footage of Unique Fluid Behavior in Space
by NASA Johnson
1,868,545 views
2:05
Space Station Live: Cultivating Plant Growth in Space
by NASA Johnson
54,708 views
5:09

The obvious advantage to using animated desktop backgrounds is the fact that you can take any video footage you want, convert it, then throw it on your desktop. Admittedly, this may not be for everyone, because moving image backgrounds are an acquired taste. However, for those looking to spruce up their desktop, there's no better way than with a constantly-shifting one.

One thing to take note of is the inevitable hit on performance your rig will take while running one of these. In our testing, we found that, at a minimum, the process was consuming anywhere from 12 to 17 percent of performance. However, if you have any window enabled in full-screen mode, DeskScapes freezes the looping video until you click back on the desktop, negating this problem. But it's still something to bear in mind.

Stitch photos in Photoshop

YOU'LL NEED THIS

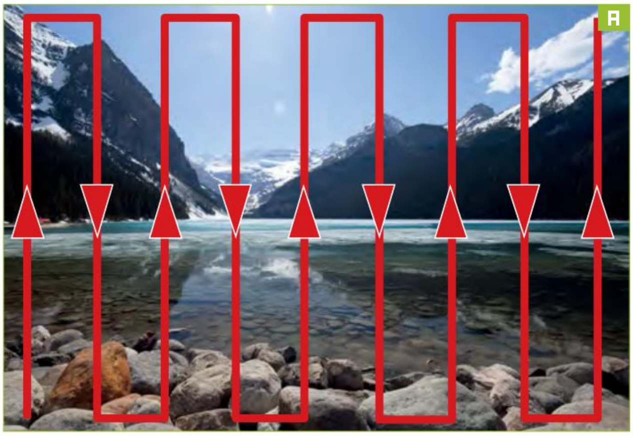
CAMERA
A DLSR is ideal, but any digital camera should do.

PHOTOSHOP, GIMP, PHOTOSHOP ELEMENTS
Any layer-based image editor—we use Photoshop here.

YOU'RE OUT FOR A HIKE in one of our wonderful national parks, indulging in your second favorite hobby: bird spotting. You've got a DSLR with a long lens to capture any cardinals or blue jays you see flitting through the trees, but left the wider ones in your truck to cut down on weight. Suddenly, you stumble across a beautiful vista. Struck breathless by its beauty, you raise your camera to your eye, only to find that your telephoto lens can only capture a small sliver of its majesty. What do you do?

You use your PC to help. The latest high-end PCs have a lot in common with the workstations used for image-editing—plenty of RAM (file sizes can get pretty big) and a decent CPU, and some photo-processing software can take advantage of your GPU to speed up its operations, too.

So, next time you're out in the wild, take a moment to sit and appreciate the natural beauty, and take the shots necessary to create a gigantic, stitched image when you get home. –**IAN EVENDEN**



1 PLAN FIRST

You're not going to be able to do this without the raw materials. Plan the route your camera will take across the view you want to capture, visualizing it as a grid within a rectangle. Focus and stop down your aperture for extra depth of field. If you can set your camera to manual exposure and focus, this will help the end result come out more even [**Image A**]. Then, using a short telephoto focal length (don't zoom during the process), begin to take pictures. Start in the bottom-left corner of your imaginary rectangle, and make your way up to the top-left, moving the camera up in stages, and taking a picture each time that has some overlap with the one below. Once you get to the top, move across slightly and shoot your way to the bottom, then across, then up... and so on until you reach the top-right corner of the vista. Capture a bit more than you need, because we'll be cropping in later.

2 REPEAT

Unless you've brought a laptop out to the mountains with you, there's no way of knowing whether you've captured the shots correctly, so it's worth repeating the entire process a couple times to make sure at least one pass gives a good result. Memory cards are pretty cheap right now.

3 CONVERT TO JPEG

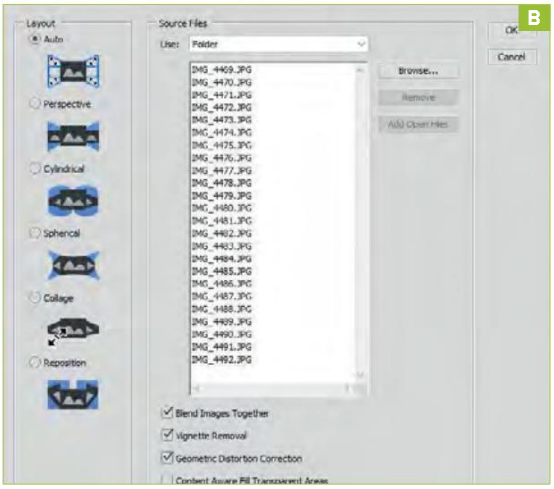
Once you get back to your PC and have fortified yourself with coffee, the real fun can begin. Sort out the images you've taken in your runs across the magnificent view into separate folders, because this will make processing them easier. If you've been shooting raw images, export them to JPEG using the raw processing software of your choice, but make sure the develop settings are identical for them all, because we don't want some parts of the final image to be darker than others [**Image B**].

4 DOWNSIZE YOUR IMAGES

If you can, it's worth creating smaller versions of your images to speed up processing—a grid containing six columns of 18MP images will be around 30,000 pixels across in the final stitched image, which is far too big for any sensible use. Stitching 4MP files will still give you a final image file in the 60MP range, just in case you want to print it on a billboard.

5 USE PHOTOMERGE

Open your image editor (we're using Photoshop CC, but others will do the job just as well—although they may have different command names). From the "File" menu, select "Automate," then "Photomerge." Keep the "Auto" setting at the left, at least for your first try, then select "Folder" from the drop-down in the middle, and hit "Browse." Point the dialog that appears to the folder you sorted a promising run of images into.



● Auto

Use: Folder

IMG_4469.JPG
IMG_4470.JPG
IMG_4471.JPG
IMG_4472.JPG
IMG_4473.JPG
IMG_4474.JPG
IMG_4475.JPG
IMG_4476.JPG
IMG_4477.JPG
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IMG_4484.JPG
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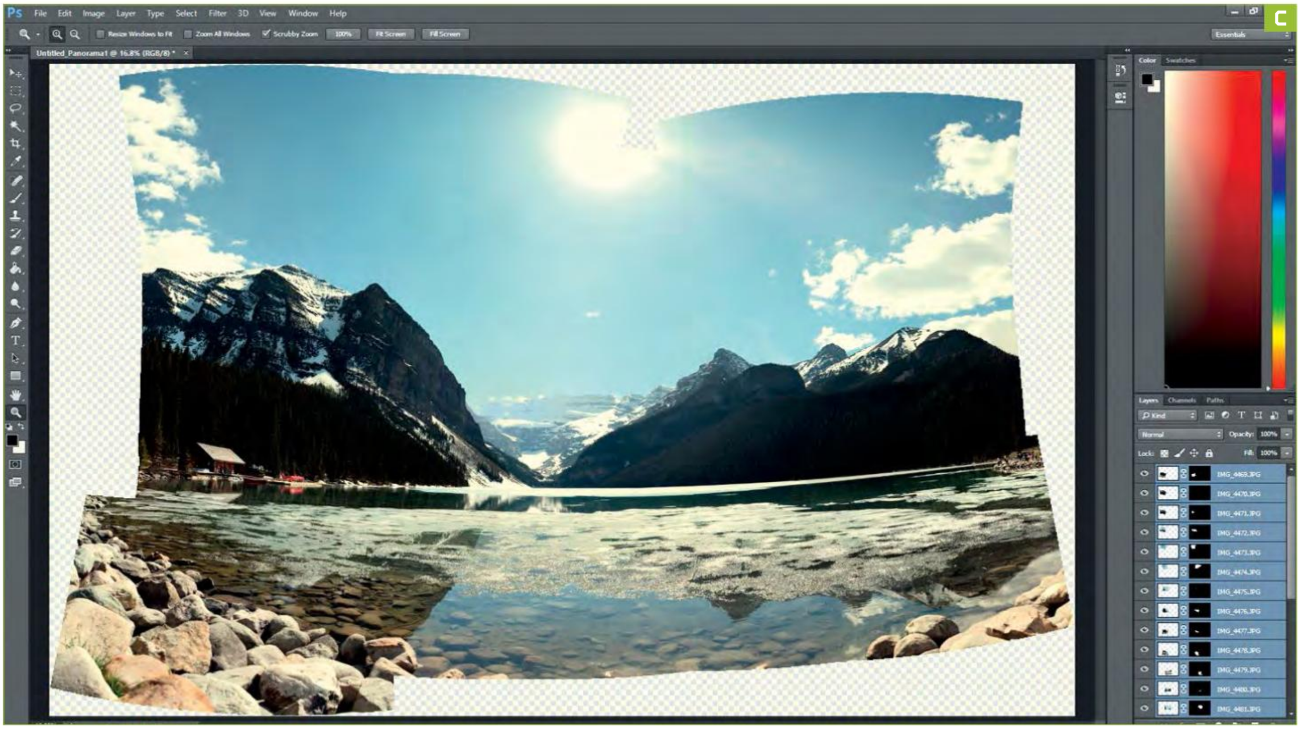
IMG_4488.JPG
IMG_4489.JPG
IMG_4490.JPG
IMG_4491.JPG
IMG_4492.JPG

☑ Blend Images Together
☑ Vignette Removal
☑ Geometric Distortion Correction
☐ Content Aware Fill Transparent Areas


C
File Edit Image Layer Type Select Filter 3D View Window Help
Untitled_Panorama1 @ 16.8% (RGB/8) *
Layers Channels Paths
Normal
Opacity: 100%
Fill: 100%
IMG_4469.JPG
IMG_4470.JPG
IMG_4471.JPG
IMG_4472.JPG
IMG_4473.JPG
IMG_4474.JPG
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IMG_4476.JPG
IMG_4477.JPG
IMG_4478.JPG
IMG_4479.JPG
IMG_4480.JPG
IMG_4481.JPG

6 WAIT A WHILE

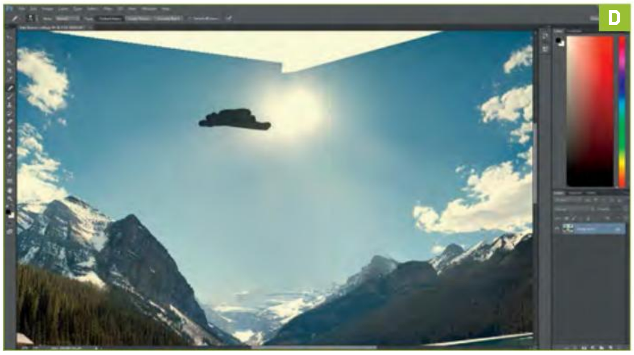
Confirm this folder, and the process of image analysis and stitching begins. Refill your coffee and grab a donut while it's working [**Image C**], as it's not a spectator-friendly business, and even on a quad-core i7 can take several minutes, depending on the size of the images you fed it initially. Bring up a monitoring utility and watch your CPU usage and fan speeds spike.

7 RE-RUN IF NECESSARY

Examine the result and decide if you're happy with it. Chances are you won't be, so re-run the merge with different settings. It's worth ticking "Vignette Removal" on the "Photomerge" dialog if your lens tends to create dark corners in your images, as these are often most pronounced at a zoom lens's shorter focal lengths.

8 TWEAK ANY DISTORTION

Changing the blend mode from "Auto" to "Perspective" can help if your image appears distorted, or try "Cylindrical" if your final creation bows in the middle. If you missed some bits when taking your initial photos, or didn't quite join up or overlap all your images, "Content Aware Fill Transparent Areas" attempts to fill in the gaps, but it's not always 100 percent successful, tending to create repetitions that are very noticeable.



9 BLEND IT AWAY

If you find a slight misalignment of one of the photos has led to a noticeable edge halfway across, use the Healing Brush tool (the Photoshop tool icon looks like a band-aid) to clean it away [**Image D**]. The software attempts to blend your repair into the background, and it's possible to make it completely invisible.

10 READY TO PRINT

Unless you were pin-point accurate in your initial image capturing, you will end up with uneven edges. Use the Crop tool to turn it into a perfect rectangle, setting the desired aspect ratio in "Options." Flatten the layers and save your merged image as a TIFF, then use "Image → Image Size" to shrink it before exporting it as a smaller JPEG ready for posting online or printing.

BRENIZER METHOD

Decrease the depth of field in your image by placing a subject in your image a short distance from the background. Manually focus on the subject, then use the same technique as we've used in Step 1, taking pictures in a grid across the imagined rectangle of your frame. In the final blended composition, the subject will be sharp and in focus, and pop out from the image because the background will be blurred away. If photographing a person, make sure they move very little, if at all, while you're shooting the photos. The very large files you create in this way are perfect for making enlargements from, but make sure every join is blended away first, as they become more noticeable when printed big.

BUILD IT

ALEX CAMPBELL ASSOCIATE EDITOR

The Poor Man's NAS Setup

What do you do with all your old components when you upgrade? Turn them into a NAS

LENGTH OF TIME: **1–3 HOURS** LEVEL OF DIFFICULTY: **EASY**

HOME-BREWED NETWORK-ATTACHED STORAGE

IT CAN BE TEMPTING to keep revisiting the same theme in a build. After all, most of the PCs we put together are geared toward games, games, and more games. Most of the money we see in a build goes toward graphics cards and CPUs.

But not every computer you build needs to be a super-wicked-awesome gaming rig that warps space-time with eight cores and SLI. Sometimes, you just need somewhere to store your stuff.

When you upgrade your PC's CPU, a new motherboard is often in the works as well. From there, it's easy to simply go ahead and upgrade all of the core components. What you have left is basically an unused PC. But what if you could give those old components a second lease of life? FreeNAS is an operating system that offers just that.

The FreeNAS OS is built on the foundation of FreeBSD, a free software implementation of UNIX. We took some of the recommendations of FreeNAS into consideration when we scrounged together some parts lying around the Maximum PC Lab to create a low-power, quiet PC that we could use to store and serve up files.

SCAVENGING FOR PARTS

WHEN WE WENT LOOKING FOR PARTS, we had a good selection to choose from. However, most of our parts are high-octane, fire-breathing performance cards and processors. We wanted to make this build a low-power machine, because it would be on all the time.

The other challenge was finding parts that fit FreeNAS's recommended specs. We found an old LGA-1156 Celeron that we were hoping to use for its ultra-low power consumption, but the single core fell below the spec set by FreeNAS. Instead, we laid our eyes on an LGA-1150 Pentium G3258. The G3258 is a conflict-free dual-core processor with a TDP of just 53W. That's more than the Celeron would have been, but we had to use what we had.

We matched this with a Gigabyte micro-ATX Z97 board we weren't using. The motherboard is overpowered for the CPU it's paired with, but we liked the fact it had 6Gb/s SATA3 connections, instead of the old SATA2 we'd have been stuck with had we gone with the Celeron.

For storage, we grabbed four 7,200 RPM 6TB WD Blacks that we used for the Dream Machine. While these aren't the best to use in a NAS, they are large capacity and come with a five-year warranty. For RAM, we went with 8GB of Corsair XMS 3 DDR3-1600.

We stuck everything into the Fractal Design R4 mid-tower. We chose this for its soundproofing features, and because it offered plenty of space for four drives, and was languishing away in our lab.

INGREDIENTS

PART		STREET PRICE
Case	Fractal Design R4 (Arctic White)	$110
Motherboard	Gigabyte Z97M-D3H	$109
CPU	Intel Pentium G3258	$60
Memory	8GB (4x 2GB) Corsair XMS3 DDR3-1333	$70
HDD	4x 6TB WD Black 7,200 RPM	$1,120
PSU	Enermax Revolution X't 530W 80Plus Gold	$80
USB Flash	16GB PNY Attaché USB 2.0 flash drive	$6
ODD	Plextor PX-LB950SA Blu-ray writer	$160
Total		$1,715

1

A SMART APPLIANCE

AS WE USED a little dual-core Pentium, and overclocking wasn't planned, a stock heatsink and fan were fine. The low profile of the fan improves the airflow of the case.

If you're building this at home, an old Core i3 or i5 would work well. If you've got an AMD board, using an FX CPU or A-series APU will work, too, even though FreeNAS recommends going with Intel. If you're rolling with team red, just try to use a CPU or APU with the lowest TDP you can, as this machine will be on all night and day. Your CPU usage is unlikely to max out, so power draw will be a small percentage of the processor's maximum draw.

The DIMMs are Corsair XMS3 DDR3-1333. We had a 6GB kit (three 2GB sticks), so we checked model numbers before throwing them together for a total of 8GB.

2

RACK 'EM UP, PACK 'EM IN

IF THERE'S ONE ESSENTIAL feature of a NAS, it's large-capacity hard drives. We took four 6TB WD Blacks and mounted them up front, next to a fan to keep them cool.

If you can, we recommend going with enterprise-grade HGST drives, though they're pricier than their consumer desktop counterparts. It's good practice when using RAID to use identical models and capacities.

FreeNAS implements RAID through software in ZFS, and refers to it as RAIDZ. To take advantage of RAID, you need a minimum of two drives for RAID 0 or 1, three for RAID 5, and four for RAID 6 or 10 (or 0+1). Keep in mind that RAID is not the same as a backup; it simply protects you against a physical drive failure. If you use cheaper desktop drives, you have to replace them more often.

One more thing: FreeNAS doesn't recommend using a hardware RAID controller.

3

THE BARE MINIMUM

WHEN LOOKING FOR A MOTHERBOARD, it can be tempting to use just any board. However, there's a gotcha that could be easily overlooked if your old boards have been used for gaming: Whatever board you use, make sure it has video output.

While you're checking out the back panel, take note of what connections are there. Does it have HDMI? DVI? VGA? Make sure whatever is there matches up with what monitor(s) you have. While a NAS won't need an attached monitor for day-to-day operation, you'll need one to install the OS. It's really annoying to feel like you're all set up, just to find out you need to go to the local electronics store for a video adapter.

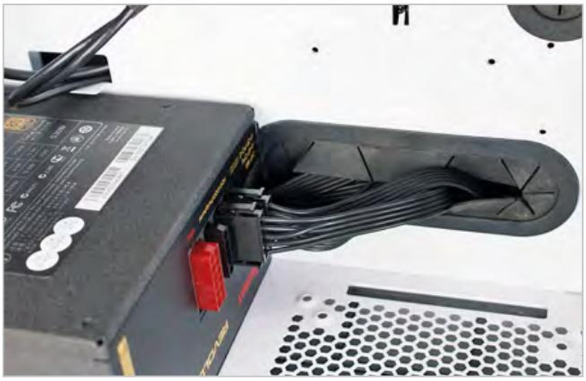
Other connections such as eSATA, FireWire (IEEE-1394), and USB 3.0 are nice, but not critical. With those, you can expand the NAS's storage (or transfer data) by attaching removable drives.

4

THE MEMORY REMAINS

ONE OF THE GREAT THINGS about building a home-brewed NAS is that the cable management is so much easier than the kind of mess you'll find in a gaming PC. That is, if you use a modular power supply.

If you've got a modular power supply, take the PCIe power cables and store them in a box somewhere. All we're worried about is the SATA, ATX, and CPU power cables. Connecting your SATA power should be a breeze, and as long as you employ some sanity, you shouldn't need more than one (or two, depending on your vendor) for an array of four drives. In our build, we included a Blu-ray drive for good measure, and had to run a SATA power cable to it. Our other SATA cable had four connections on it, which was enough to power our four WD Blacks with one run.



5

ENTER NINJA MODE

THE MAIN REASON we chose the R4 was that it had been designed with acoustics in mind. For a machine that's intended to be always-on, noise can be an issue, especially if you place it in a guest room or near a bedroom. While you may be fine with the whirring of fans, spouses, significant others, and visiting in-laws may not be so understanding.

As you don't want to have to turn off the NAS because of your mother-in-law, mitigating noise can be a priority. The padding inside the R4 absorbs a lot of sound, while offering options for airflow with top and side mounts for fans. We prioritized placing fans in the front to cool the hard drives.

Making sure the case doesn't have LED lighting you can see from space is a big plus, too. A home NAS should be like a data ninja: neither seen nor heard, yet highly effective.

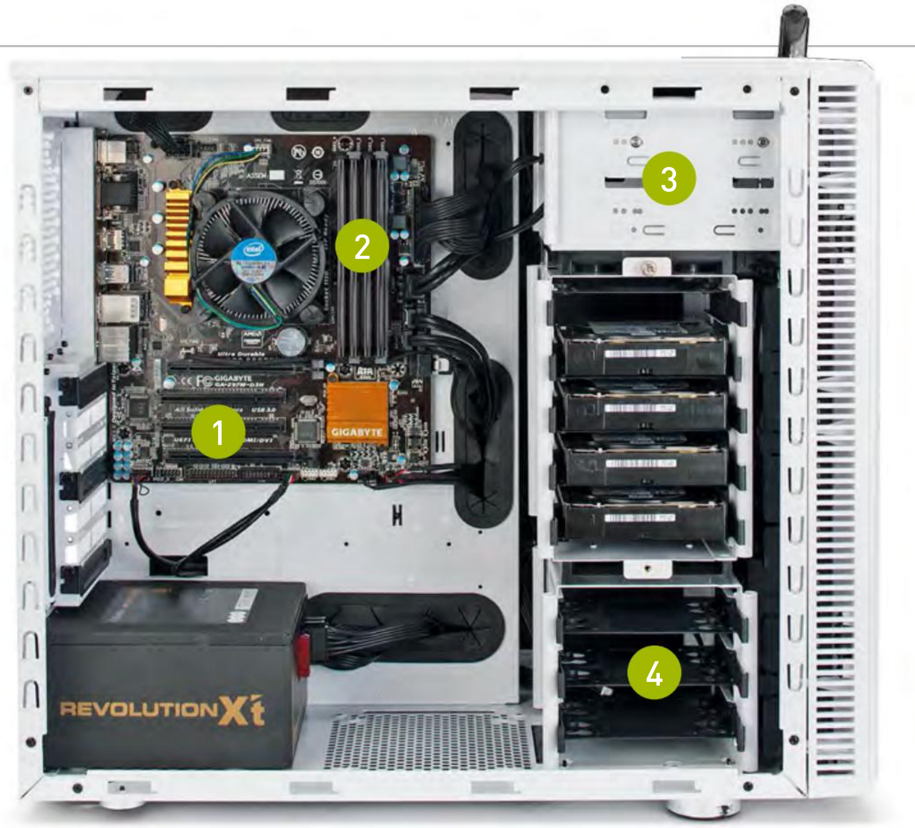
6

ONE KEY TO RULE THEM ALL

FREENAS RECOMMENDS you install the OS on a removable USB thumb drive. Your NAS doesn't need constant access to a speedy SSD; all the storage is going to your RAID array. As the OS is headless, there's no need to store bulky graphical assets for the OS or expensive graphics libraries. Boot times are irrelevant, as the NAS is meant to stay on.

Also, FreeNAS can encrypt the filesystem on your hard drives. To decrypt the files, the OS needs access to key files, which it has to store somewhere. By putting the OS on the USB key, you can render the hard drive array unintelligible by removing the USB key. If the decryption keys can't be recovered, the encrypted data is basically destroyed.

The second stick is for installing the OS. If you use a USB drive instead of an SSD, the stick you put the installation files on can't be the same stick you install the OS on.



① **The lack of a graphics card makes this desktop motherboard look barren. That's not all bad, because the PCIe slots can be used to add additional network interfaces or SATA connections.**

② **We used 8GB of non-ECC RAM in this build. FreeNAS recommends 16GB of ECC RAM for more demanding business applications, but 8GB is good enough to start with for home applications.**

③ **While you don't really need one, we went ahead and included a Blu-ray writer for good measure. This can be handy if you want to make optical disc backups.**

④ **We used a USB stick to house the OS, but you can always install it on an SSD or small HDD if you feel like it. Or you can use the empty spots in the cage for more hard drives.**

ALL THE FINE PRINT

IT'S ONE THING to build a home file server from recovered parts; it's another to build the most optimized system for the job. With regards to FreeNAS, there are several considerations when it comes to picking the choicest parts.

First, servers aren't the same as desktops. A lot of server applications can run on desktop hardware but they run best on server hardware. In the case of FreeNAS, an ideal system would make use of a Xeon processor, ECC RAM, and enterprise-grade hard drives.

If you plan on making your NAS do a lot of computational heavy-lifting, it pays to use a more powerful CPU. We got away with our little Pentium because we didn't expect a big CPU load. We also preferred low power consumption over performance. But if you want to do a lot of transcoding and other operations on the NAS, use a beefier CPU.

When it comes to RAM, there are long discussions online about the potential dangers of using non-ECC RAM. ECC RAM differs from non-ECC RAM in that it performs self-checking of bit integrity. The fear of using non-ECC RAM is that bad bits could be written to disk, and scrubs (processes that keep a ZFS pool healthy) could exacerbate bad bits, potentially corrupting the whole filesystem, resulting in losing the pool altogether. In effect, there is a danger that non-ECC RAM could cause something that's meant to be a protective feature of ZFS to be its downfall.

This is enough to scare anyone into thinking that ECC RAM is the only way to go, but there are important considerations. First, ECC RAM is much, much more expensive than non-ECC RAM. Secondly, there's very little chance that your desktop motherboard supports ECC RAM. Thirdly, your CPU needs to support ECC RAM in order to use it. See where this is going?

Matthew Ahrens, one of the co-founders of the ZFS project (he currently contributes code to ZFS for Delphix), dispelled fears that non-ECC RAM would bring your FreeNAS pools crashing down. In an Ars Technica forum post he said, "There's nothing special about ZFS that requires/encourages the use of ECC RAM more than any other file system." He continued to say that using non-ECC RAM with any other filesystem (such as NTFS, Ext3, or others) has about the same amount of risk of destruction as using non-ECC memory with ZFS.

Extrapolating from Ahrens' post, the danger of loss of your ZFS pool is likely the same as the random loss of the data on your desktop due to RAM errors. That danger is slim, but enough to make ECC a must for mission-critical applications. But your DVD collection isn't mission-critical (unless you really can't live without *Animal House)*. For home use where cost is a consideration, non-ECC RAM is fine. If you're building a business on your NAS, the cost of ECC RAM is a cost of keeping the business up and running.

If the sky would burn red hot like the pits of hell if you lost your data, it probably warrants a backup. A NAS is a handy appliance to have. It keeps your data accessible and frees you from concerns that you'll always need to pack extra gigabytes of free storage on your device. But it's not a backup, unless it's backing up another NAS.

Finally, we have hard drives. We used WD Blacks, but many desktop hard drives aren't built with NAS applications in mind. This is part of the reason the 3TB Seagate Barracuda got a lot of flak. The cloud storage provider BackBlaze collected statistics and found that 3TB Barracudas failed at a higher rate (26.7 percent) than other drives it used.

The 3TB Barracudas' average age was about 2.5 years. As it turns out, the 3TB Barracuda only has a two-year warranty. On top of that, the Seagate Barracuda isn't meant for enterprise server and NAS applications. (Neither are the WD Blacks we used.) And remember, a cloud provider is going to have way, way more I/O hits than your home NAS.

The biggest cost of the system will likely be the hard drives. Look for hard drives with high capacity and a good, long lifespan. (The length of the warranty is a good indicator.) HGST offers great, reliable NAS and server drives, but they also cost more. Cheaper drives such as the Barracuda can get the job done, but will have a higher replacement rate.

Even though this build topped the $1,700 mark, we still like to think of it as a poor man's NAS, since we used parts that were past their prime or languishing in a corner. By keeping true to the core requirements (multicore CPU, 8GB RAM), you can build a home FreeNAS box out of just about any hardware you can scrounge together. Go ahead—give those old parts a new lease on life.

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REVIEWS

TESTED. REVIEWED. VERDICTIZED.

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The Surface Pro keyboard is sold separately, but you'll definitely need it.

Surface Pro 4

A coming-of-age tale

WHEN THE ORIGINAL Surface Pro came out in 2012, it was seen as the awkward redheaded stepchild in both the tablet and laptop scenes. Through multiple iterations and levels of refinement, the two-in-one convertible has finally begun to blossom. It's now seen as edgy and practical. It's Microsoft's Ugly Duckling story, if you will.

As with the Surface Pro 3, Microsoft maintains its unique 3x2 aspect ratio, but bumps up the resolution to 2736x1824. The 12.3-inch screen looks absolutely crisp. Its size makes it a little awkward to hold as a tablet, but its built-in kickstand enables you to prop it up at just about any angle. All of this is housed in a silver-colored magnesium casing, which feels premium and cool to the touch.

One gripe that we had with past Surface models was that Microsoft sells the keyboard separately, and that problem persists. Even with its $130 price tag, we consider the keyboard to be vital to the Surface experience (and have adjusted the overall price at the end of this review to reflect that). Despite the small size, the Surface Pro 4 keyboard is actually very good. There's pretty much all the same keys you would find on an Ultrabook, including arrow keys, and it has a subtle LED glow to it, too. It also boasts decent travel time, and a satisfying clicky noise. And the magnet that holds it in place is super strong and easy to snap on. It's so strong, in fact, that you can even dangle the Surface upside-down holding nothing but the keyboard.

The trackpad is a bit small, but it does the job for the most part. There was one instance where it wasn't very responsive, but we suspect it was a software issue and haven't encountered the situation since. While the keyboard isn't included, Microsoft does include a stylus, which works well and snaps on to the side of the Surface magnetically when it isn't needed. We really liked the speakers as well, which sounded plenty loud and clear.

Most of the improvements to the Surface Pro 4 are under the hood. In conjunction with Windows 10 is Intel's new mobile Skylake CPU. Ours came with a Core i5-6300U, clocked at 2.4GHz, but you can get it in Intel Core i3 and i7 flavors as well. Coupled with the CPU is Intel's HD 520 graphics. Compared to our new zero-point, Dell's XPS 13 (reviewed in the August 2015 issue), the Surface Pro 4 really does impress. CPU-wise, it was faster than the XPS 13 by up to 29 percent, giving the machine its biggest thrashing in our multithreaded test.

AHEAD OF THE GAME

It's in the graphics department where Skylake really beats on its Haswell counterpart, though, with a 29–36 percent lead. In real-world terms, we were able to play *CS:GO* at 1920x1440 resolution, with medium settings, and AA turned off at around 50fps. That's not bad, and is certainly playable. You should be able to play a lot of popular non-taxing games on this at either low or medium settings. The Pro 4 was also extremely quiet during our gameplay sessions. In terms of battery life, the Pro 4 lasted 270 minutes in our rundown test. We also saw similar numbers in our real-world experiential test, with the convertible keeling over after 290 minutes. It's OK, but probably won't last you all day.

The biggest sins of the previous and current Surface models are the compromises they make as both a laptop and a tablet. There were times when we forgot that it's not a laptop, and tried to pull the monitor towards us, only to have it almost flop face-first, down on to the keyboard. In addition, while you can put it on your lap, it isn't as comfy or stable as a laptop. Another gripe we had is that it only has one USB port; most Ultrabooks offer more. Still, we think the Surface works better as a laptop than a tablet. Typing with Windows 10's built-in virtual keyboard is uncomfortable due to the tablet's large size—this issue is only complicated further because the digital keyboard lacks swipe gestures and predictive text.

Still, those issues aside, this is the best Surface Pro yet, and it even beats several top-tier Ultrabooks in performance. It's also super-easy to carry around in a backpack. We're just not sure whether there is a truly "all"-in-one device out there just yet. –**JIMMY THANG**

VERDICT
9

Surface Pro 4

⊞ **PRO** Super-sharp screen; extremely portable; fast and quiet; adjustable hinge.

⊟ **NOOB** Keyboard sold separately; only one USB port; makes concessions as laptop and tablet.

$1,430, www.microsoftstore.com

BENCHMARKS

	ZERO-POINT		
Stitch.Efx 2.0 (sec)	1,710	1,447	(16%)
Proshow Producer 5 (sec)	2,392	2,343	(2%)
x264 HD 5.0	5.2	7	(29.5%)
Tomb Raider (fps)	24.9	33.4	(29.1%)
3DMark 11 Performance	1,094	1,575	(36%)
Battery Life (mins)	223	270	(19%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

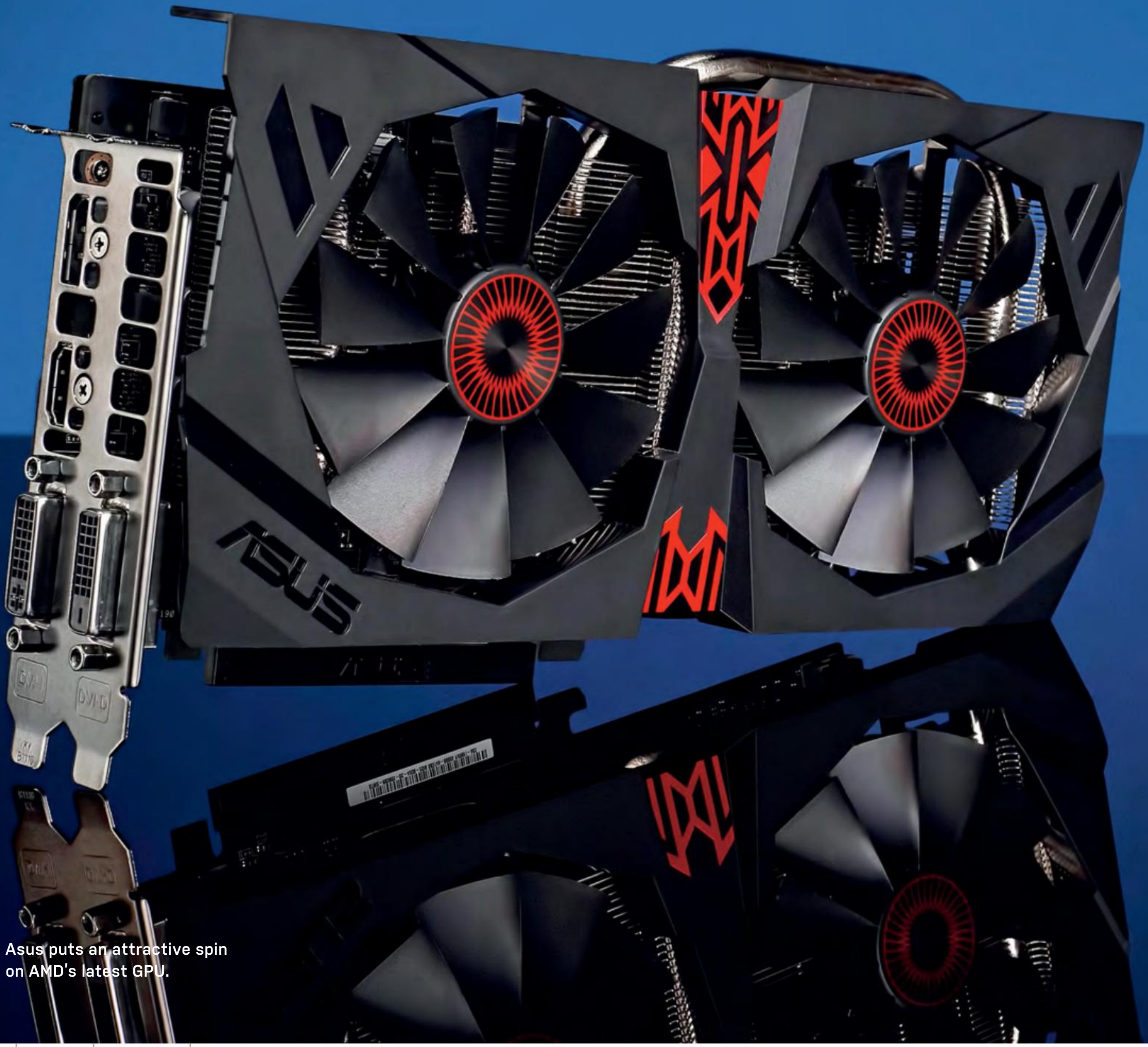
Our zero-point Ultrabook is a Dell XPS 13 with an Intel Core i5-5200U clocked at 2.2GHz, with 8GB DDR3 RAM, running Windows 10 64-bit. 3DMark 11 was run in Performance mode; *Tomb Raider* was run using low settings.

SPECIFICATIONS

CPU	2.4GHz Intel Core i5-6300U
RAM	8GB
Display	12.3-inch 2736x1824 IPS
Storage	256GB SSD
Connectivity	1x USB 3.0, microSD card reader, Mini DisplayPort, 802.11a/b/g/n, Bluetooth 4.0, headphone jack
Tablet/Laptop	1.73lb/2.41lb

Asus Strix R9 380X OC

Fitting neatly between the R9 380 and 390, AMD's latest isn't half bad



Asus puts an attractive spin on AMD's latest GPU.

CAST YOUR MIND BACK to September 10, 2014. AMD had just released its first GCN1.2 graphics chip, codenamed Tonga. Launched as the R9 285, generally available with 2GB GDDR5, but later with 4GB, Tonga contained new architectural enhancements, chief of which was the use of lossless delta color compression. This allowed AMD to cut the memory bus down from 384-bit to 256-bit without impacting performance too much, along with several other tweaks and optimizations.

The net result of these changes was a less expensive graphics card to manufacture compared to its predecessor (Tahiti), and it offered similar overall performance. The catch with the earlier launch of Tonga in the form of the R9 285 was that it featured the same 1,792 graphics cores as R9 280 (aka HD 7950), with a couple of functional units disabled. The rumored R9 285X never happened, but one year later, we're now getting the fully enabled release of Tonga XT with the R9 380X, complete with 2,048 graphics cores.

Checking out the specs, the key takeaway is that the R9 380X is fundamentally the same as the R9 380, but with more cores. It has the same clock speeds for the GPU core and GDDR5 memory, so the only advantage is having 14 percent more cores. The MSRP for the standard card reflects these facts, with a price only 15 percent higher than the R9 380. AMD notes that add-in board partners may charge slightly more for custom coolers, which is the case for our review sample. As the trailing two letters suggest, the Asus Strix R9 380X OC isn't stock clocked. Along with the custom cooler, the core is overclocked slightly—the GPU runs at 1,050MHz, as long as the overclocking button is pressed in GPU Tweak II. It may be nearly four years since the 7970 was released, but the "new" R9 380X barely outpaces that venerable GPU. On the surface, that might not seem very impressive, but there's a reason AMD positions the 380X as an upgrade path for owners of the HD 7850. When the 7970 launched in 2011, it was a monster card, but it carried an equally monstrous price tag. Now you can get nearly the same performance, using less power, for less than half the price.

TESTING TIMES

For a more up-to-date comparison, the R9 380X outperforms the R9 380 by just under 10 percent, although drivers seem to be a bit iffy in a couple of tests. Nvidia's chief competition comes in the form of the GTX 960, which is available in either 2GB or 4GB variants. The 2GB model is what we have for testing, and there are certainly games where the limited VRAM is a factor. Considering the 2GB cards are priced closer to the 380, while the 4GB cards are priced roughly equal to the 380X MSRP, drawing a final conclusion is difficult. What we can say is that 380X wins the battle at 1080p Ultra and 1440p Ultra by nearly 20 percent against the 2GB card. The gap at 4K is even larger, but it's not really a target resolution for either GPU.

Looking at the big picture, the R9 380X is a good GPU that's able to handle 1080p gaming at maxed-out settings in most titles, and when it falls short (*GTA V* and *The Witcher 3,* for example) it's usually not too difficult to drop to high quality or disable anti-aliasing to get back to playable frame rates.

The R9 380X is where GPUs start to get truly potent, but without the higher price tags. It's half the price of the R9 390X and 66 percent of the performance—a fair compromise. The only problem is timing—the R9 380 is only 5-10 percent slower and has been around for several months, so it's difficult to imagine many people have been waiting for the R9 380X. Even so, if you are building a new PC and are in the market for a $200-$250 graphics card, the R9 380 and 380X have that market locked up for now. –**JARRED WALTON**

VERDICT
8

Asus Strix R9 380X OC

+ TIME TRAVEL Great price-to-performance ratio; runs quiet; faster than the competition.

− DELOREAN Less efficient than Nvidia's Maxwell; little different from R9 380.

$229, www.amd.com

SPECIFICATIONS

GPU	Tonga XT
Lithography	28nm
Transistor Count	5 billion
Die Size	359mm²
Compute Shaders	32
Shaders	2,048
Texture Units	128
ROPs	32
Core Clock	1,030MHz
Memory Capacity	4GB
Memory Clock	5,700GT/s
Bus	256-bit
TDP	195W

BENCHMARKS

	R9 380X	GTX 950	R9 390	GTX 970	R9 380	GTX 960
Batman: Arkham Origins	93/59	75/41	**140/87**	113/67	88/54	76/46
Fallout 4	58/40	40/27	**70/51**	66/43	53/37	48/30
Grand Theft Auto V	43/28	34/21	**60/41**	58/38	39/26	40/26
Hitman: Absolution	51/35	38/23	**77/54**	62/40	51/34	40/25
Metro: Last Light	57/37	48/31	**78/52**	77/51	54/35	59/38
Middle-Earth: Shadow of Mordor	65/47	38/25	**88/65**	74/52	62/44	40/30
Tomb Raider	70/49	53/34	89/**61**	**94**/56	64/43	63/42
The Witcher 3	37/28	26/20	**47/37**	46/34	33/25	33/24
Eight-Game Average	59/40	44/28	**81/56**	74/48	56/37	50/33

Best scores are in bold. Results are average fps at 1080p/1440p. Our test bed is a 4.2GHz overclocked Core i7-5930K in a Gigabyte GA-X99-UD4 motherboard, with 4x 4GB DDR4-2666, 1TB Samsung 850 Pro, and EVGA SuperNOVA 1,300W G2, running 64-bit Windows 8.1.

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AMD Athlon X4 860K Black Edition

What's the price of an integrated GPU? About 50 bucks, apparently

THE EAGLE-EYED AMONG YOU will have noticed that this isn't a brand new processor. The AMD Athlon X4 860K was originally released about a year ago, but has suddenly become a far more relevant processor than when it first launched.

It's all about the money, as usual, as the cost of this AMD chip was recently cut in half. That makes it a far better option for a low-end, budget-oriented gaming machine, and we reckon you're going to start seeing your friendly local (and not so local) system integrators putting together a host of micro machines rocking this cheap little chip. After all, if it costs us $75 to pick up a single unit, imagine the bulk order discounts for PC builders buying a whole tray of inexpensive silicon.

QUICK FIX

So, where has it come from? When chips are manufactured, inevitably there will be individual chips that don't function to their full potential due to silicon imperfections. Some work fine at lower clock speeds; others have faulty functional units. AMD's APUs contain both CPU and GPU components, and it makes sense to use chips where you can't rely on the graphics side as straight processors.

That's what happened with the 860K. Specifically, this is a "harvested" A10-7850K without the GPU bits. It's a basic Steamroller chip, rocking two modules; AMD calls it a quad-core CPU, as it has four integer cores, with each module sharing a single floating point unit. It's also the cheapest quad-core processor you can buy, about three-quarters the cost of AMD's FX-4350.

There is an important caveat with this CPU though, and that's where you can use it. Because the 860K is a cut-down APU, it needs to run in an FM2+ motherboard, which means you don't have the same access to all the high-end stuff. Though with this being more of a budget offering, that's not an issue.

What might be an issue is that this is a dead end when it comes to your upgrade options down the line. This isn't going to be the beating heart of a machine that will grow along with your CPU needs. The only processor upgrade you'll be able to perform would be to change up to a fully functional A10-7850K, or an incrementally faster A10-7870K, but all that will get you is an integrated GPU. As we're talking about this being a base for a budget gaming rig, the need for that weakheart graphics core is minimal at best.

A GAMING APU?

The performance of the Athlon X4 860K is a known quantity. We've tested the A10 APU this is born from, and it performs almost identically. That's great from the point of view that it's up there with a pricier processor, but it means you "only" get the same performance as the A10. AMD APUs aren't the chips of choice for most gamers, as they hobble the peak performance of any graphics card when compared with their performance alongside Intel processors.

That said, if you compare it with a similarly-priced, stock-clocked Pentium Anniversary G3258 chip, those "four" cores make a difference. The performance of the 860K's extra cores and clock speed gives it the edge, and then there's the fact that modern game engines are starting to need more than resolutely dual-core CPUs.

And what of overclocking? We managed to get a healthy 4.4GHz clock speed that seemed stable—unfortunately, when given a light Cinebench thrashing, it refused to hold, throttling its clocks right down. In the end, as the base for a real budget gaming build, this cheap quad-core chip is adequate, but nothing more. **–DAVE JAMES**

VERDICT **7**

AMD Athlon X4 860K Black Edition

⊞ **ATHLETIC** Decent clock speed; unlocked; bargain price.

⊟ **ATHLETE'S FOOT** Limited OC performance; dead-end platform; holds back GPUs.

$75, www.amd.com

BENCHMARKS

	AMD Athlon X4 860K	AMD A10-7850K	Intel Pentium G3258
Cinebench R15 Single-Thread	88	91	**117**
Cinebench R15 Multi-Thread	306	**311**	235
X264 V4.0	23.96	**24.17**	16.93
Total War: Rome 2 (min/avg fps)	25/44	27/46	**34/53**
Battlefield 4 (min/avg fps)	30/49	**37/51**	31/45
Peak Platform Power	130W	131W	**83W**

Best scores are in bold. Testing platform: 8GB DDR3 @ 1,600MHz, GTX 980, Windows 10 64-bit.

SPECIFICATIONS

Socket	AMD FM2+
Core Technology	Steamroller
Clock Speed	3.7GHz
Boost	4GHz
Cores	4
Lithography	28nm
Cache	4MB
TDP	95W

SABERTOOTH
Z170

A NEW ASUS TUF SABERTOOTH is always something special. This is because the brand is one of the most influential and innovative motherboard lineups ever released. To give weight to this claim, it's worth noting how many firsts the brand has accrued: It was the first board to introduce a full armor covering; it was the first board to introduce full PWM fan control, with a dedicated onboard cooling processor; it was the first board to include a full rear cover to hide those garish I/O connectors; and from 2009 onward, it's a board that's been built around budget endurance as opposed to top-of-the-line performance. We've often referred to the Sabertooth lineup as Asus's workhorse because of that very fact.

So this is the Sabertooth Z170 Mark 1, the fifth iteration of Asus's TUF (and you really should read that as "tough") lineup. What's different, besides support for DDR4 and Skylake? Well, thanks to the additional PCIe lanes found in the Z170 chipset, Asus has taken a leaf from the X99 Sabertooth's book and thrown in an M.2 slot, hidden discreetly under the armor just south of the chipset, enabling storage speeds up to 32Gb/s. On top of this, Asus gives you another two SATA 6Gb/s ports, and some additional rear I/O in the form of USB 3.1 type A and C. Plus, there's a TUF Detective 2 port—another addition from its X99 cousin—enabling you to plug your phone directly into the motherboard to diagnose any potential boot problems.

A big selling point of this motherboard is how it looks. Go on, take a glance at that image over on the right—isn't it gorgeous? Asus continues to improve the Sabertooth's armored appearance, and the ethos apparent here. Black motherboards are incredibly popular, and for good reason—they're sleek and subtle, and once you hide all of the guts under that minimal aesthetic design, it creates a build as clean as a whistle. We still have to deal with a smattering of beige connectors, but if you're inventive when it comes to positioning your hardware, it's entirely possible to hide them away, to produce a wonderfully clean build.

SATA Express still litters the board, although it's a far cry from the initial bombardment that we saw from other manufacturers. Asus has always kept a minimal count of only one per Sabertooth, and this is no different. Perhaps this is for those looking to utilize Asus's USB 3.1 front 5.25-inch panel.

You can also install two miniature fans with this board. One can be hidden under the rear I/O, providing an intake of cool air from outside the chassis. The other replaces the TUF badge in the center of the motherboard, pulling hot air out from under the PCB and venting into your case. Both of these help improve the overall airflow, and are a neat addition for anyone looking to build a super-cool system.

STUNNING PERFORMANCE

As far as Z170 boards go, this is quite the performer, too. We've always been impressed with the Sabertooth range, and this one is no different—scoring higher in our standard benchmarks than any other Z170 we've looked at. And it isn't just a pretty face—it's no pushover when it comes to overclocking either, hitting an astonishing 4.85GHz through the 5-Way Optimization software that Asus includes as standard.

All in all, this board is incredible for the price. It looks great, it overclocks like a monster, and the auto-overclocking performance is a stunning one-click wonder. The only downsides we can think of are the lack of an LED POST display—although there is the TUF Detective 2—and there are no onboard power buttons. But, honestly, that's just us being picky. Oh, and get rid of the beige, Asus. **–ZAK STOREY**

VERDICT
9
KICK ASS!

Asus Sabertooth Z170 Mark 1

⊞ BIG KITTY Stunning overclock potential; fantastic aesthetics; brilliant cooling; hidden M.2 slot; USB 3.1 type A & C.

⊟ LITTLE KITTY Still has beige on it; lacks LED POST display; no onboard power buttons.

$250, www.asus.com

SPECIFICATIONS

Chipset	Intel Z170
Socket	LGA 1151
Form Factor	ATX
Memory Support	DDR4/3733
Storage	8x SATA, 1x M.2, 1x SATA Express
USB	6x USB 3, 6x USB 2, 1x USB 3.1 Type A, 1x USB 3.1 Type C

BENCHMARKS

	Asus Z170 Sabertooth	MSI Z170A Gaming M7
Cinebench R15 (index)	**930**	923
x264 HD Video Encoding (fps)	**20.55**	20.39
Memory Bandwidth (GB/s)	29	**30**
Shadow of Mordor @ 4K (average fps)	**27**	**27**
Maximum Overclock (GHz)	**4.9**	4.7
Cinebench R15 at Max OC (index)	**1,045**	1,008

Best scores are in bold. All tests were performed with an Intel Core i7-6700K, 16GB of DDR4 Corsair Vengeance LPX memory, a GeForce GTX 980, and a 250GB Samsung Evo SSD.

Asus Sabertooth Z170 Mark 1

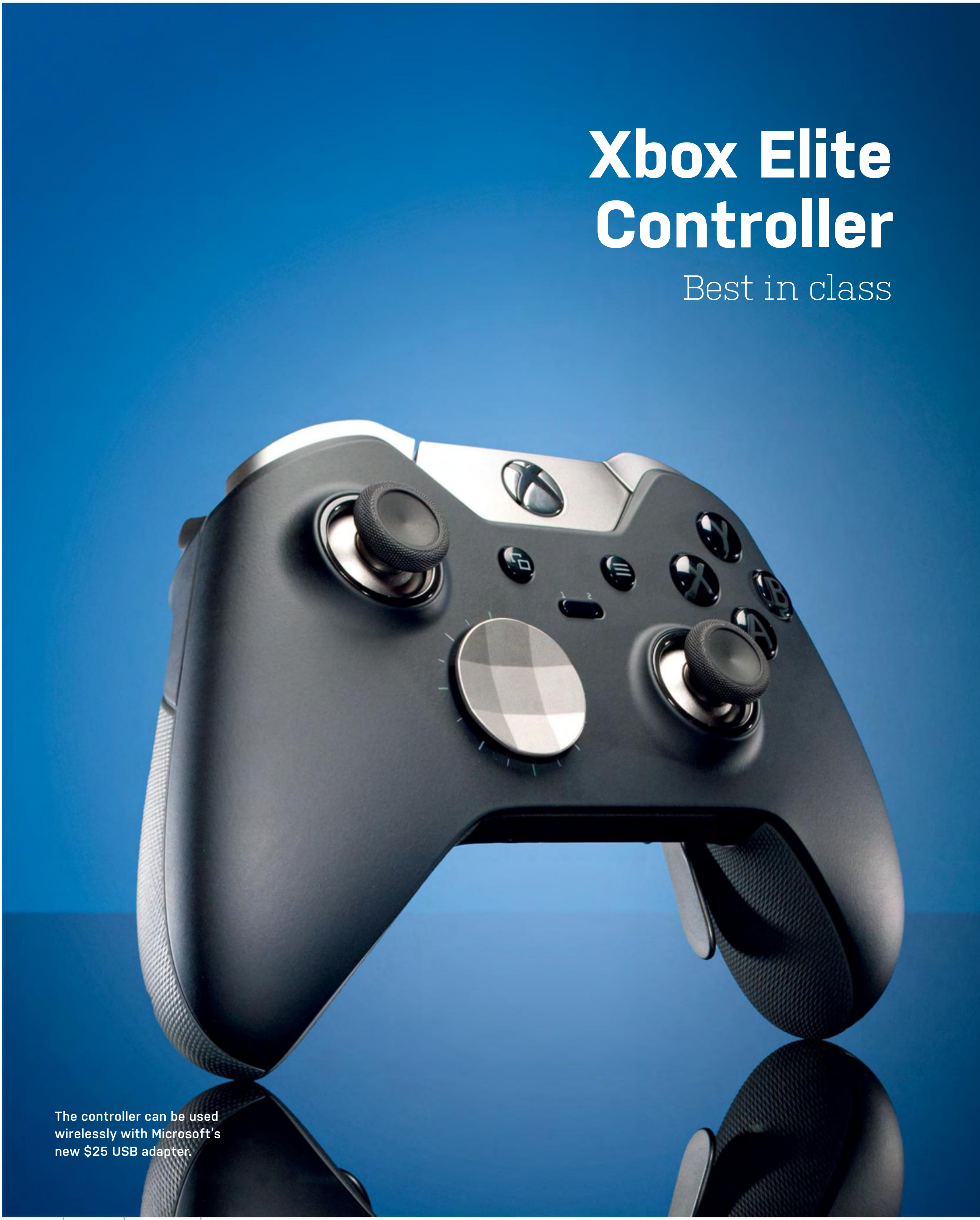
Who doesn't love a bit of armor, huh?

THE ULTIMATE FORCE
THERMAL ARMOR
ASUS

The cornerstone of Asus's TUF lineup is here, and wow—she's a beauty.

Xbox Elite Controller

Best in class



The controller can be used wirelessly with Microsoft's new $25 USB adapter.

THE PC IS NO STRANGER to high-end gaming peripherals. We've got super-fancy RGB mechanical keyboards that sport a wide array of switch types, and we have luminescent gaming mice with crazy DPI options. There is also a multitude of high-end gaming controllers, including Valve's recently released Steam Controller, which offer a ton of customization options. Not to be outdone, Microsoft has now unleashed its own beast: the Xbox Elite controller. What makes the controller "elite"? Well, first off, at $150, perhaps only the elite will be able to afford it. That said, it really does look and feel super-premium, and offers more than enough customization options.

The first thing you'll notice about the controller is its looks, which are damned sexy. Its bold black-and-silver design is a thing of beauty. When you pick it up and hold it in your hands, you'll notice how premium it feels. Microsoft uses some high-end rubber materials and expensive steel components here, and the end result feels comfortable and built to last. You'll also notice that the Elite has four paddles on the back, which mirror the controller's ABXY face buttons by default, though you can change that using the Xbox app on Windows. While you can customize these buttons to be whatever you want, we actually preferred gaming without them in most cases, because we sometimes found ourselves accidentally clicking them. Luckily, these back buttons are just held on by magnets, and you can take them off easily if you want.

Other bold changes to the controller include a range of d-pad and thumbstick mounts. In addition to your traditional d-pad configuration, Microsoft has also bundled a satellite-looking d-pad that you can swap in. We really liked using this satellite-style d-pad; it made shooting fireballs in fighting games much easier than the controller's more traditional d-pad. As a matter of fact, despite its unusual look, we'll go out on a limb and say it is arguably the best fighting-game d-pad out there.

The two joysticks also get a lot of attention—Microsoft has included three pairs of swappable sticks. So you get the traditional concave sticks, but Microsoft has also thrown in a pair of taller concave sticks, and a PlayStation-style dome setup. The tall sticks are a little too tall for our liking, and the dome-style sticks didn't offer as much grip as the regular sticks, so we ended up sticking (no pun intended) with the original pair. It is worth mentioning that you can mix and match these sticks as you please, and that all these sticks and d-pad mounts are held on magnetically, so are easily swapped out. Microsoft also gives you a sweet carrying case for storing all these accessories.

ON THE BUTTON

The shoulder buttons have received some attention, as well. One gripe we have with the regular Xbox One controller is that its shoulder buttons required a little too much actuation force for our liking, but the Elite controller eases up the tension required to actuate, and it feels much more satisfying and clicky as a result. There are also two switches on the back of the controller that adjust the "throw," or travel, of the L2 and R2 buttons.

Not only can you mess around with the hardware, but the Xbox app on Windows enables you to remap all the buttons on the controller. Which means you could remap every button to "X" if you wanted to. You can also adjust the control stick dead zones, configure shoulder button travel distance even further, and there are also five different sensitivity presets to choose from. While you can create as many controller profiles as you want, you can save two local presets to the controller and switch between them on the fly in-game. This means you could have one preset for walking around, and another for sniping, which is pretty cool. You can also adjust rumble and even how bright the white Xbox button glows. While the customization options aren't crazy deep like Valve's Steam Controller, the software is pretty easy to use.

The Xbox Elite has a lot going for it, but it isn't perfect. The magnetic paddle sticks on the back would occasionally come loose; another small gripe is that when you hold down the Xbox button to turn off the controller, Steam Big Picture Mode inadvertently launches. We would have also liked it if the controller offered dual-stage triggers, like the Steam Controller, so you could lightly press on a shoulder button to aim, and then press all the way down to fire.

All in all, however, if the Steam Controller isn't for you, and you prefer traditional setups, this is the best controller in its class that we've tried out so far. It is expensive, but it's meant for professional gamers, and given the fact that high-end keyboard and mice are also super-expensive, we don't think it's too crazy to give the Elite Controller our Kick-Ass seal of approval. **–JIMMY THANG**

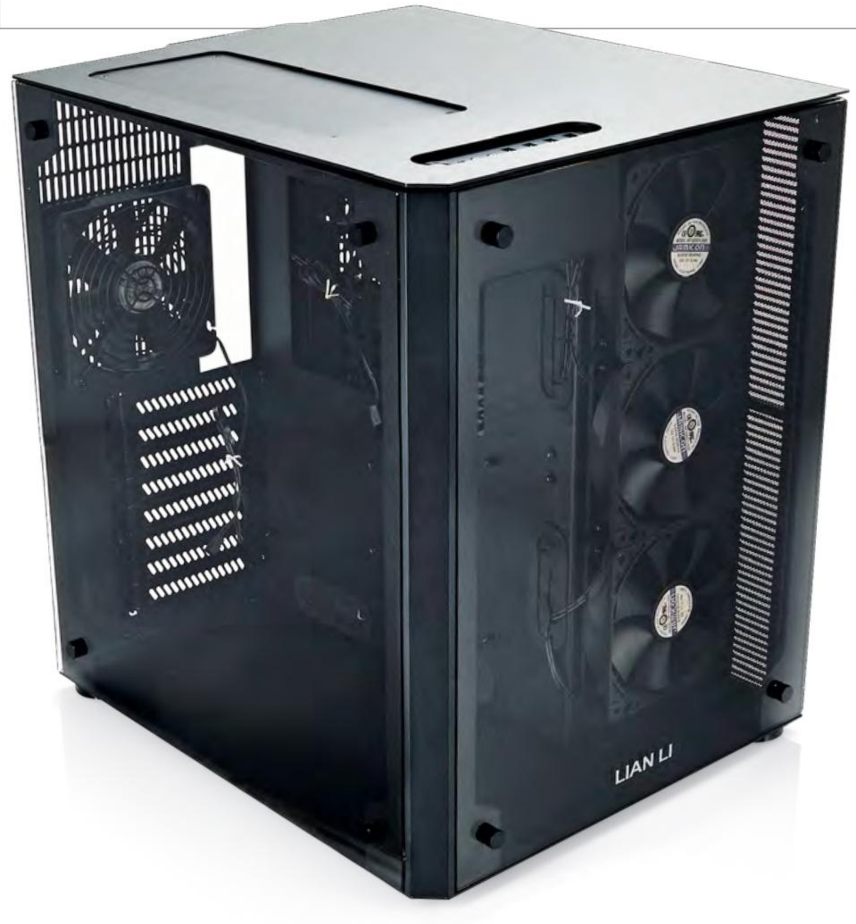
VERDICT
9
KICK ASS!

Xbox Elite Controller

+ **ELITE** Awesome new d-pad; easy-to-use software; premium design; plenty of sticks to choose from; included audio jack.

− **DESTITUTE** Expensive; paddle sticks can fall out; no dual-trigger design; accidentally launches SBP on shutoff.

$150, www.microsoftstore.com



Lian-Li PC-08

1970s hi-fi or futuristic PC cube?

WHAT CAN WE SAY? Just wow. What a case! This is the PC-08 windowed chassis brought to us by Lian-Li. Coming in at an incredible $390, this cube-like design by the world-renowned Taiwanese case maker follows the company's long tradition of utilizing a full-aluminum chassis in conjunction with its entry point into the high-end premium market. And as far as cases go, it certainly doesn't disappoint—although, would you really expect anything else at this price?

The PC-08 is phenomenally well constructed; even the raised feet are formed from solid blocks of that versatile metal. On top of that, the brushed finish is beyond words. It almost feels delicate, giving the roof and frame a beautifully premium finish. And considering the design of the chassis, it's incredibly strong, even minus the reinforced glass panels. There's some clever engineering going on, or some seriously thick aluminum—either way, we're impressed.

Of course, we have to talk about those windowed side panels. Laminated glass is the name of the game here. Specifically, two smoked sheets of the stuff adorn the front and side of the chassis, showcasing all of the cleverly laid-out internals within the entire case. The intake fans, visible behind the front-facing panel, pull in air from a dust-filtered side vent. What this means is that, although at first glance this triple setup of 120mm air-pullers does seem rather pointless, they have more than enough room to breathe, and actually serve an interesting dual purpose, due to the design decisions behind the interior layout of the case.

IN THE AIR

All three 120mm fans pull in cold air from outside the chassis, at the same time dumping some of the warm air generated by all of your hardware from the main compartment out and into the rear hard drive compartment of the chassis as well. This is incredibly innovative, as although the case lacks any obvious intake, the circulation and flow of air around the whole case is more than enough to circumvent any thermal problems within Lian-Li's closed-off cube design.

As far as watercooling is concerned, it's admittedly not the best case for your H_2O pursuits. You're limited to a 360mm radiator in the front, 240mm in the roof, and a 120mm in the rear of the case, maximum. Although it's not impossible to delve into those murky depths, you'll need to think out your runs very carefully. Especially if utilizing a radiator in the front of the chassis, because there's not a lot of space between the front glass panel and the radiator assembly, once fully installed. There'll be some tight 90-degree bends involved, that's for sure.

Ideally, this case is best suited for those looking to build a quick, clean, show build, with a solid and dependable AIO CPU cooler. It's crisp, it's clean, and it's phenomenally well constructed. If you're thinking of just throwing some reference graphics cards in there, a single 240mm AIO liquid cooler, and a hell of a lot of hard drives, this might be the most ideal case in the world. But for watercooling, you might want to rethink those ideas, as the PC-08 simply doesn't cut the mustard. That said, it's a fantastic case, and we'd love to see a design from Lian-Li integrating these intuitive features in a fully watercooling-ready tower chassis. –**ZAK STOREY**

VERDICT
9

Lian-Li PC-08

+ **FUTURE PROOF** Stunning design; innovative cooling system; compartmentalized chassis; fully aluminum chassis.

– **SMUDGE MAGNET** Price; limited water-cooling options.

$390, www.lian-li.com

SPECIFICATIONS

Form Factor	E-ATX, ATX, Micro-ATX
Dimensions and Weight	13.4x16.9x15.9 inches; 21lb
Cooling	Front: 3x 120mm (included) Top: 2x 120mm Rear: 1x 120mm (included) HDD rack: 2x 120mm
CPU Cooler Clearance	6.7 inches
Graphics Card Max Length	14.6 inches
Storage Support	6x 3.5-inch HDD mounts; 2x 2.5-inch SSD mounts

Zowie FK1

Painfully precise professional rodent

AT FIRST GLANCE, this mouse may not look like much. It's a far stride from the usual hyper-ergonomic, multi-colored, wireless, adjustable gaming mice we tend to feature. But that's exactly what makes this mouse so special. It's not about the glitz and the glam, it's about making you the best damn gamer you can be.

So who is Zowie? Well, in short, it's a tiny company, founded in 2008, with the distinctive goal of creating perfect gaming peripherals for pro-gamers. But that's nothing we've not heard before, surely? Take a look at SteelSeries, Razer, and Logitech, and you'll discover a similar ethos driving all those companies. What makes Zowie different from the rest is how it works as a company. It's a brand that's not seeking to become a market leader, it doesn't answer to shareholders, and it's certainly not hoping to break any world records for the number of mice sold. No, its mission statement is plain and simple: "We just want to be the best. If we can develop products that will increase a gamer's performance by just 1 percent, we will do it. This is our mentality." And, boy, does it show in its products.

What makes the Zowie FK1 so special? Well, for starters, it's one of the few ambidextrous mice available that achieves pixel-perfect accuracy. The Avago 3310 sensor is already a favorite among gaming professionals, but here there's no interpolation of movement, there's zero jitter, and there's absolutely no angle snapping. It's perfectly precise. In theory, you could move this mouse across the screen one pixel at a time with complete and unparalleled smoothness. The FK1 achieves this by keeping everything integrated into the mouse itself—there are no drivers to install, and there's nothing to configure on the desktop.

A simple button located at the bottom of the mouse enables you to adjust between 400, 800, 1,600, and 3,200 dpi. There's no noise between the mouse's movement and what you see on the screen. Some of this is achieved thanks to that Avago 3310 optical sensor buried at the heart of this pinpoint-precision machine, and the rest is due to Zowie's engineering prowess, because beyond the sensor, Zowie has managed to achieve an impeccably low lift-off distance of 1.5-1.8mm.

ON THE BUTTON

You also get a set of Blue Huano switches providing solid and dependable button action. You can confidently and rapidly click away, safe in the knowledge that each actuation counts. And speaking of buttons, you're not going to encounter many on this mouse—besides the obvious ones on top, you only have access to two on either side of the FK1. Those looking for an MMO or MOBA configuration may want to look elsewhere. That isn't the market this mouse is designed for—the FK1 is for first-person shooters, for those who need painstakingly precise accuracy with every single shot.

The FK1 is an incredibly fast, responsive, lightweight monster of mayhem. Its entire focus is on e-sports, and that's reflected in its engineering—all of which is centered around Zowie's fanatical pursuit of those marginal gains. Ultimately, it does the basics stunningly well, utilizing some of the very best mechanical components in the business to pull together an absolutely phenomenal ambidextrous piece of hardware. If you're serious about playing first-person shooters, then this mouse should definitely be at the very top of your wish list. **–ZAK STOREY**

VERDICT

9

Zowie FK1

⊞ **RAPID REFLEX** Pixel-perfect sensor; surprisingly comfortable; ambidextrous; simple design; driverless; Avago 3310 optical sensor; low lift-off distance.

⊟ **POINT & CLICK** No quick DPI adjustment on top of mouse; not ideal for MOBA or MMO; no soft-touch finish.

$70, www.zowiegear.com

SPECIFICATIONS

Sensor	Avago 3310 Optical Sensor
Lift-Off Distance	1.5–1.8mm
Polling Rate	125/500/1,000Hz
Max Sensitivity	3,200 dpi
Programmable Buttons	7
Weight	0.2lb

QNAP TVS-EC1080+ NAS

A NAS for the power-hungry

THERE ARE NASES, then there are über-NASes. The QNAP TVS-EC1080+ is one such über-NAS. Pitched as an enterprise-level unit, the TVS-EC1080+ packs killer hardware features as well as a host of applications that users should find handy. So, what does a $3,300 NAS get you?

QNAP spares no expense, tossing in a 3.4GHz quad-core Xeon processor, 32GB RAM, dual 128GB SSD caching, and 10 full open bays. Make no mistake, this beast can do much more than store your family photos. Small to medium-sized offices would find the TVS-EC1080+ useful, especially with its large capacity and integrated 10GbE support. The primary function overall for this unit is to serve files or databases, and serve them fast.

In a business environment, most of the software features won't be used. Photo backup, photo serving, torrent downloading, and media playback are some of the features available out of the box but we're more interested in performance. The TVS-EC1080+ is no more difficult to set up and use than any other NAS in QNAP's lineup, and it operates much in the same way as the TVS-871 we previously reviewed. We just installed the hard drives into their cages and plugged them in. You can configure the storage via the built-in HDMI interface or by logging in to its web interface—but there's only so much you can do with the two-line built-in display.

We configured our TVS-EC1080+ with equally impressive drives from HGST in

ENTER
STATUS
LAN
USB
eSATA
HGST
AUG-2015

This is the most powerful 10-bay NAS you can buy.

the form of the Ultrastar He8 8TB helium drives. HGST offers the Ultrastar He8 in both SATA and SAS, but the TVS-EC1080+ only supports SATA. The Ultrastar He8 drives are fast and offer copious amounts of capacity, and are perfect for a NAS such as this. We filled all 10 bays with HGST Ultrastar He8 drives for a total raw capacity of 80TB. RAID users be warned though: At these monstrous capacities, chances for an array failure sky rocket, and RAID rebuild times will be a nightmare.

PRO PERFORMANCE

Performance is stellar, of course, thanks to the Xeon CPU and 10GbE network support. But performance is only one of the TVS-TC1080+'s faces. Well-heeled home users will find lots to do with the TVS-TC1080+, while business users will no doubt be excited about its scalability and ease of use.

For business users, the TVS-TC1080+ is a powerful starting point. The NAS can be expanded with dedicated expansion units, but be warned: You'll lose the ability to use 10GbE because the 10GbE card needs to be swapped out for an SAS card. The onboard caching is also going to be great for database storage, where a large number of users would have the NAS hitting the cache SSDs often. In a home environment, the SSD will stay inactive almost all of the time.

If you're in a need of serious storage capacity and performance for NAS apps in a single unit, the TVS-TC1080+ is essentially your go-to unit. But no one should buy this behemoth simply for storage capacity. You'll get the most out of it if you need to run programs such as virtual machines, and support multiple simultaneous users. Simply put, the TVS-EC1080+ is overkill for home use. Xeon processors notwithstanding, it's very difficult for a home environment to take advantage of the hardware inside the TVS-EC1080+. But if you must have an über-NAS, the TVS-EC1080+ is one such option. **–TUAN NGUYEN**

VERDICT
9
KICK ASS!

QNAP TVS-EC1080+ NAS

+ BEASTLINAS 10GbE; 10 drive bays; SSD caching; can be used as a PC; five-year warranty.

– UGLINAS SSD caching useful only in specific situations; no SAS support.

$3,300, www.qnap.com

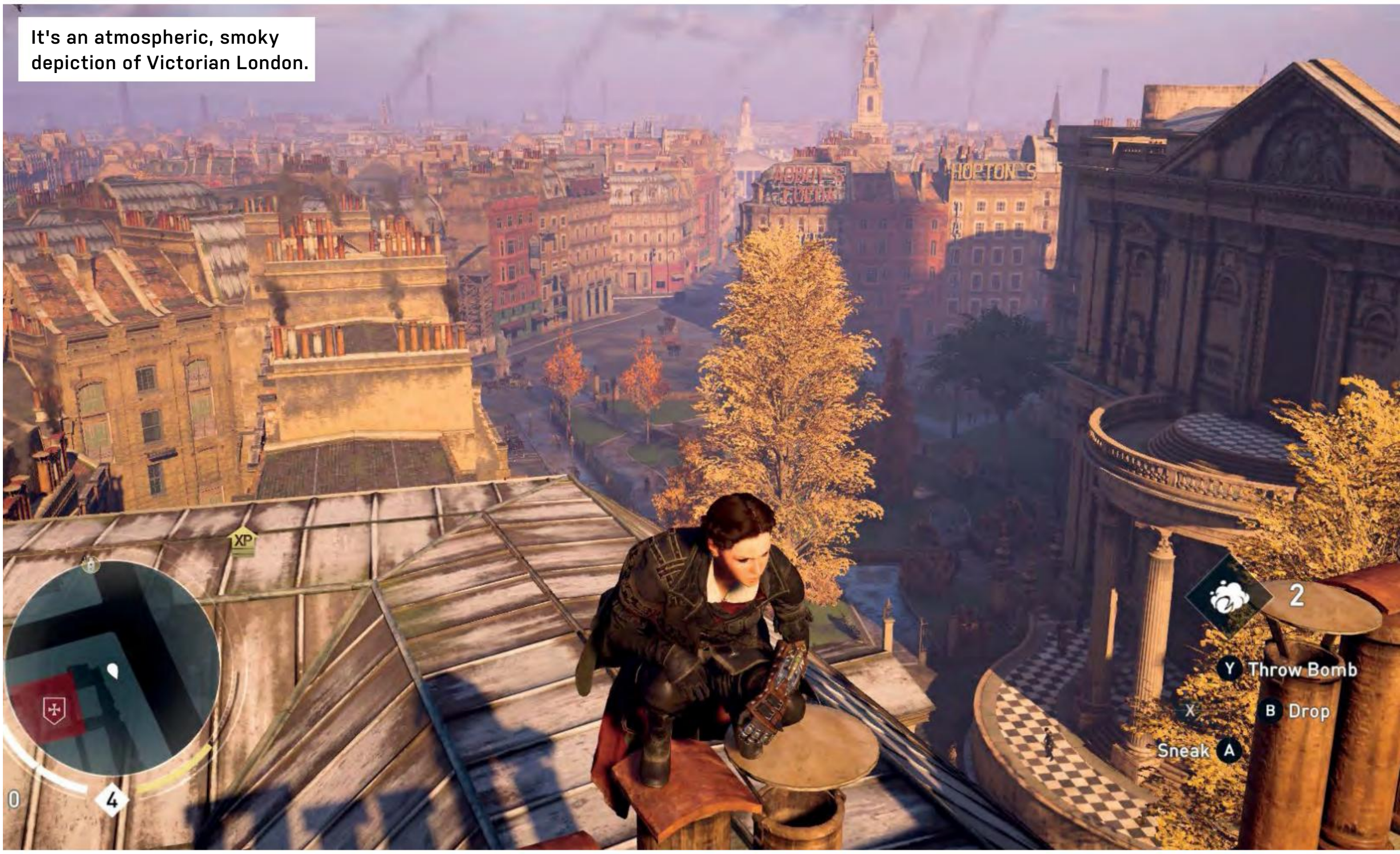
QNAP
POWER
COPY

SPECIFICATIONS

CPU	Intel Xeon E3-1245
Cores	4
Speed	3.4GHz
Installed Memory	32GB
Memory Upgradable	Yes
OS	QTS 4.1
USB Ports	3x USB 3.0, 6x USB 2.0
HDMI Ports	1x 1.4a
Ethernet Ports	2x 10 Gigabit, 4x 1 Gigabit
Others	2x eSATA ports
Warranty	5 years

BENCHMARKS

File Copy Write RAID 0	1,781.3MB/s
File Copy Read RAID 0	1,797.2MB/s
File Copy Write RAID 5	1,567.1MB/s
File Copy Read RAID 5	1,686.6MB/s
File Copy Write RAID 6	1,559.0MB/s
File Copy Read RAID 6	1,564.7MB/s
File Copy Write RAID 10	939.5MB/s
File Copy Read RAID 10	1,729.3MB/s



It's an atmospheric, smoky depiction of Victorian London.

Assassin's Creed Syndicate

Strike a light! It's that time of year again!

THERE'S AN ARGUMENT that the recently released *Fallout 4*, with its bugs and creaky engine, shows that its developer concentrated on the important things, such as fun and character. And *Fallout 4* is certainly a very good game. *Assassin's Creed* exudes a level of polish the wasteland can only dream of, but does that mean other important aspects have been overlooked?

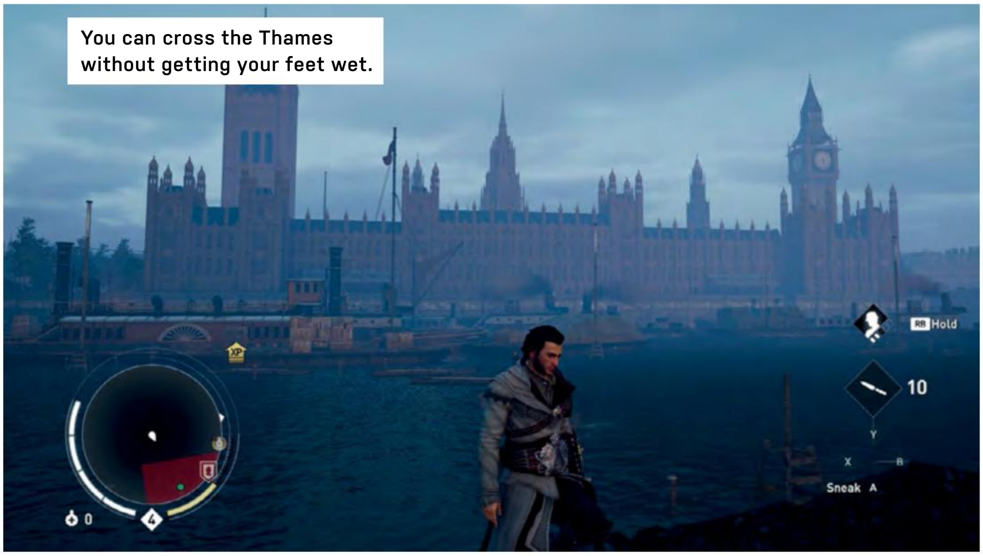
AC games follow the same rhythm as *Star Trek* movies. The first was pretty good, the second and its follow-up games were better. Number three was a bit of a duffer, then four majestically pulled the series back on to its sea legs (and featured whales—this analogy totally works!) before five, last year's *Unity*, had horrific PC performance issues at launch, and went on to let the side down, with a return to muddy Europe and a more structured program of stabbings. Taking this to its logical conclusion means 2017's game will be *First Contact*, and therefore awesome.

Syndicate sadly does not feature the rampaging near-future team of minigun-armed cyborgs the title would suggest, instead taking a trip to Victorian London. That's London, England—not Ohio, Kentucky, or Ontario—a city which, as you may know from watching Disney's 1964 docu-drama *Mary Poppins*, is a place where the rooftops are alive with honest citizens trying to earn a few pennies, and you're never more than six feet from a cartoon penguin. *Syndicate* is set a mere 42 years prior to *Mary Poppins*, yet while its city is certainly alive with citizens, it's rare you'll find an honest one, and the only Poppins are the occasional texture snafu.

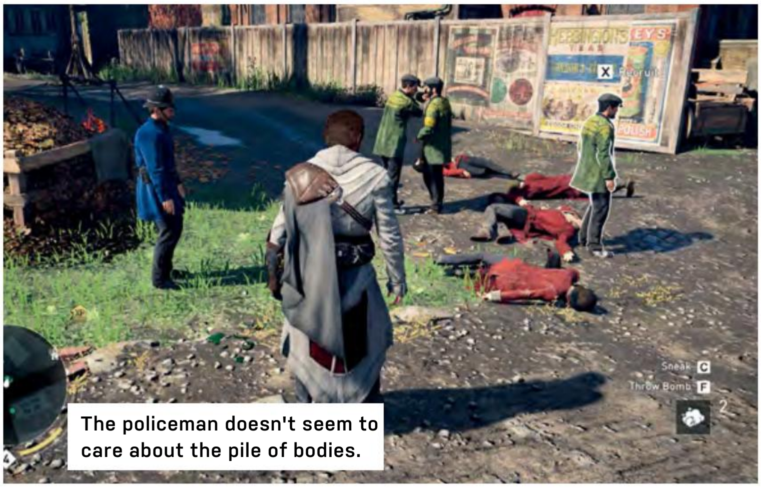
We encountered minor bugs: a chair that merged with a lady's voluminous skirts; a gang member caught on a fence, vibrating on the spot; an NPC seated as though driving a carriage, appearing in mid-air before sinking into the ground; and the camera getting confused when Evie went through a significant door, arriving on the other side before her, and causing the freckled assassin to quickly glide over the ground, rather than walking, to catch up. But there's been none of the launch-time hilarity of *Assassin's Creed Unity*, which saw faces fall apart (and was rapidly patched into submission).

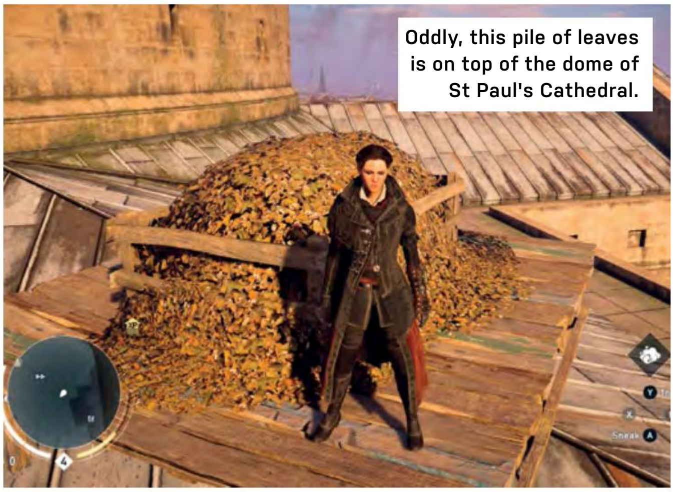
Evie is one of two protagonists, twin assassins with a nice line in long coats and hidden weaponry. Her brother Jacob is more combat-focused, while Evie is better at sneaking. The RPG-like skill tree makes it possible to power both up so much it no longer matters which one you're playing as.

From their steam train base, the twins are trying to take over London, one district at a time, with their gang, the Rooks, through the time-honored methods of street-fighting, kidnapping, doing favors for historical figures, and running at things while holding the right mouse button down (or the right trigger, as this is a game that begs to be played with a controller), before getting into cover and stabbing someone. The idea is to defeat rival gangs and, therefore, series bad guys, the Templars. If you've played all the previous *AC* games, you'll know all about the absurd "Pieces of Eden" MacGuffin-hunt that passes as a meta-narrative, linking all the titles in a baffling and inconsequential way. You can


You can cross the Thames without getting your feet wet.

Aaaaaaaaaaaaaaa aaaaaaaaaaaagh!


The policeman doesn't seem to care about the pile of bodies.


Oddly, this pile of leaves is on top of the dome of St Paul's Cathedral.

ignore everything about it, but it would be interesting to know if UbiSoft has an arc planned out for future games, or just makes up the setting and events on the spot.

Your map is packed, with collectibles, missions, shops, and treasure chests all marked. At times, the game seems keen to take you by the hand and lead you through the streets of London (there's a line on the road for your carriage to follow), but at others shows you something to change your mind, such as gang members who, unable to keep up with their mistress's leaping and ziplining across the city, hail a carriage and arrive at their destination promptly. The AI isn't always this smart, however, with piles of bodies going unremarked, and a child's chirpy "I can see you!" failing to alert guards to an assassin's location.

MEMORY LANE

The game is a heavy consumer of hard drive space (40GB) and VRAM, with a guide on its graphics options screen showing you what it wants to use. Pile on the effects and it can look beautiful, but at the cost of a plummeting frame rate. High is the middle setting, with Very High and Ultra High above it, but we found that even at 1080p with Medium settings, it's a nice-looking game—the misty effect it creates is atmospheric—and the benefits of a higher frame rate outweigh the removal of a few jaggies for those not packing a top-end graphics card.

Assassin's Creed games are as much about how you get from place to place as they are about sneaky stabbing. The new grappling hook makes it easy to access the chimney-sweep-free rooftops, and once you get into a rhythm of jumping, running, and roping your way around, you can cover large amounts of the city like goddamn Batman. There's a fast travel system, too, but as it dumps you out to a loading screen, it isn't really ideal for short journeys. Some landmarks, such as the glass roof of a bustling market building, knock 10fps off the framerate, but in general it's a smooth experience. An option to widen the FOV would be welcome, however.

Syndicate is probably the best *AC* game yet, even if it doesn't quite scale the swashbuckling heights of *Black Flag*. The setting is cohesive, and the level of graphical polish sky-high, with its London seeming very much alive and a joy to move through. Yet, as ever, what's missing is a strong sense of motivation about why the events are taking place. What *Assassin's Creed Syndicate* doesn't do is solve all the problems of the series, as the addition of more and more things to do is no substitute for the sorely-needed refinement of the basic mechanics, and the paring back of the absurd storyline. **–IAN EVENDEN**

VERDICT **8**

Assassin's Creed Syndicate

+ COCKNEYS Lovely-looking city; great freedom of movement.

– COCKEYED Wants a lot of VRAM; story still doesn't make sense.

RECOMMENDED SPECS Intel Core i7-3770 @ 3.4GHz or AMD FX-8350 @ 4.0GHz or better; Nvidia GeForce GTX 780 or AMD Radeon R9 290X (3GB VRAM); 8GB RAM.

$60, http://assassinscreed.ubi.com, ESRB: M

LAB NOTES

ZAK STOREY **STAFF WRITER**

BIOS Bugs and Software Conflicts

Beta testers, eat your hearts out

I KNOW WHAT YOU'RE THINKING: "You guys have such a cushy job, you get brand-new tech thrown at you daily. Your life's so easy." Well, yes and no. The world doesn't always work like your dreams; we're not sitting on a throne constructed from the decaying carcasses of GTX Titans. In fact, a lot of the products we get in to review have to be sent back to the manufacturers sharpish, or to other reviewers. Which causes problems.

Take the Asus Z170 Sabertooth found in this issue. It's in stunning condition, and photographs beautifully. However, the reviewer prior to us didn't reset the BIOS before shipping it out. The big problem here is that the CPU ratio, XMP settings, and voltages were all set up to operate on different hardware. So on arrival and first testing, it took us 30 minutes or so to figure out that the board wasn't a dud—we couldn't even get to the BIOS. After sorting that out, once we installed our OS and activated Asus's 5-Way Optimization software, we noticed the system and compressed memory process was consuming 12.5 percent of our CPU cycles. This looked like a problem with Asus's software, but after much discussion with the helpful folk at Asus, it turned out to be nothing more than a failed BIOS flash and a corrupt Intel ME driver.

We are often the first people to get hold of these products, and it feels likes it. I'd run out of fingers if I tried to count how many "engineering sample" CPUs we have in our cupboard. And with that comes a great deal of responsibility, to not jump to conclusions, and not declare something a dud just because it won't boot the first time. We have to chase down all of these problems, and that can be incredibly frustrating at times.

She's a stunning board, but a reviewer's life is fraught with riddles.

ALAN DEXTER

Executive Editor

My fascination with SteamOS can be likened to the relationship between moth and flame—drawn inextricably toward the burning light, I keep getting burnt for my hopes. Linux is powerful, as is the underlying hardware needed to run the latest games, and Valve has no shortage of clever people at its disposal. Somehow, though, it never quite adds up. This month has been a harsh reminder of that—Steam OS is better now than when I last looked at it, but I've still come away wondering why I, or anyone, should bother. The game support is improving, but still a long way off parity, and while Linux has a place in my life, it isn't on my gaming machine. Also, *Half-Life 3,* please.

JARRED WALTON

Senior Editor

As you've probably gathered if you're a regular reader, I love games, and *Fallout 4* is a great addition to the franchise—I've spent way too much of my free time exploring the Commonwealth. What's surprising, though, is how similar the latest game feels, graphically, to the previous two titles, especially in light of the massive jump in system requirements. *Fallout 4* runs just fine on a GTX 970 at 1080p Ultra, sure, but it simply doesn't have the visual impact of *The Witcher 3,* for example, or the latest *Call of Duty.* Don't feel bad if you have to run it at High settings, though, because Ultra doesn't actually add much to the overall experience other than lower frame rates.

Editors' Picks:
Practical Programs

Alex Campbell, associate editor, and Jimmy Thang, online managing editor, discuss their latest finds

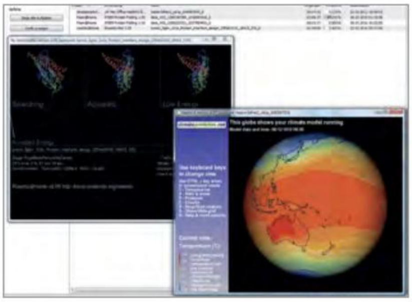
USE BOINC... FOR SCIENCE!

There is lots of software that I think is wonderful. However, little holds such a special place as the Berkeley Open Infrastructure for Network Computing (or BOINC, for short). On top of that, it's fun to say ("boink!").

BOINC enables you to donate your spare computing power to scientific projects. Using BOINC, you can sign up to participate in well-known projects such as SETI@Home (the Search for Extraterrestrial Intelligence) or Atlas@Home (one of the Large Hadron Collider experiments). There are also projects such as Rosetta@Home, which uses BOINC volunteers to find three-dimensional protein shapes to help cure diseases such as Alzheimer's and cancer.

The thing I like most about BOINC is that it only revs up your CPU (and even GPU) when you're not using the machine. You can also schedule BOINC to run at night, and set limits on CPU and GPU usage, too.

BOINC is free, and is available for Windows, Mac OS X, FreeBSD, and Linux. If you have a beefy PC that sits idle while you sleep, why not donate some of that power? It costs you nothing (except for a few extra kilowatt hours), but yields warm fuzzies in knowing you're doing science.



YOU SHOULD GET GET POCKET

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Foolproof Whole Wheat Apple Muffins

GEEK TESTED & APPROVED

FLIR One

WE'VE BUILT A LOT of PCs and laptops over the years, and one of the more time-consuming tasks is checking thermals. Sure, motherboards and processors can report a few core temperatures, but if you're wondering if the airflow in a system is working or missing some hot spots, checking temperatures with a normal laser thermometer is a pain in the butt. This would be a lot easier if you had an IR camera, but those have high price tags. Enter the FLIR One.

FLIR stands for Forward-Looking Infrared, and using a small module that attaches to your smartphone—there are iOS and Android variants—you can get a quick look at thermals for a computer system, or just about anything else. Besides looking cool, the images can tell you at a glance if there are any hot spots that could use additional cooling. Best of all, FLIR does all of this at a fraction of the cost of a normal IR camera.

The FLIR One does lack some of the features of high-end IR devices, and the image quality depends at least in part on the quality of your smartphone camera. Resolution for the images is also pretty low, at 640x480, but if you think of that as thousands of measurement points, it's actually quite good. We'd like the option to show a temperature scale rather than being limited to spot metering, but for 250 bucks, we can live with the limitations. **–JW**

$250, www.flir.com/flirone

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> The Future of RAM
> Mobo Network Ports
> VR Versus AR

Faster and Furiouser

After reading Tom Halfhill's article on XPoint technology (December 2015), I have a question: As the rate of storage memory increases in terms of transmission speed between other components, will XPoint or some other storage memory eventually remove the need for system RAM? **—Matt**

CONTRIBUTING EDITOR TOM HALFHILL RESPONDS: Hello, Matt. Yes, if any memory technology becomes faster than DRAM at about the same cost and density, then it will replace DRAM.

We already have memory faster than DRAM—it's called SRAM (static RAM). It's usually the memory found in microprocessor caches. But SRAM needs about six transistors to store each bit, while DRAM needs only one transistor. So SRAM is about six times more expensive and about six times larger than an equivalent amount of DRAM. That's why DRAM still rules for system memory. Speed isn't everything.

Also, note two aspects of DRAM speed: latency and throughput. Latency is the lag time before the memory responds to a data request; throughput is the speed at which the data flows to or from the memory. Any memory technology that replaces DRAM must have shorter latency and/or higher throughput. Historically, throughput has improved more than latency.

In general, any storage technology is subject to replacement by something faster, cheaper, or denser. Sometimes only one of those is important. For example, I replaced the HDD in my notebook with an SSD. The SSD isn't cheaper or denser—it cost about twice as much for half as much capacity—but it's much faster. My computer feels like a new machine. I don't think I'll ever go back to using an HDD for the system drive. Any notebook I buy in future must have an SSD or user-replaceable HDD.

Ports Galore

I have a question, but first want to second a letter from another subscriber: With your help, I've built three PCs. While I do some gaming, my primary use of the computer is for programming. Please keep in mind that we are not all strictly gamers.

My question is: My Asus motherboard has two gigabit network connections. But I've never understood

CUT, COPY, PASTE

* In our January 2016 issue, we mistakenly identified the Kingston HyperX Predator M.2 SSD as an NVMe drive. While the drive has a PCIe interface, it uses the AHCI protocol. You can read our corrected review online (http://bit.ly/MPC_KHXP).

[NOW ONLINE]

BENCHMARKED: FALLOUT 4

Despite the bugs, *Fallout 4* is a great game. If you're sitting on the fence about it because you're concerned about how it will run on your system, we're here to help. In our online story "Benchmarked: *Fallout 4*," we take a look at the game running on a wide variety of GPUs, covering both AMD and Nvidia cards. We also delve into how taxing the game is on your CPU, and we show you how you can get rid of the pesky 60fps frame rate limiter (yes, it has one of those). There is also a ton of benchmark charts! Check out our web exclusive at http://bit.ly/MPC_fallout4.

Fancy *Fallout 4?* We help you find out if your PC can cope.

↘ submit your questions to: comments@maximumpc.com

why. What can I do with a second network socket?
—Kraig Whiting

SENIOR EDITOR JARRED WALTON RESPONDS: Hi, Kraig. For most users, that second Ethernet port is mostly a case of feature creep—two is better than one, right? I remember building PCs back when you had to buy a separate Ethernet card, and before that, in the days of modems. As we integrated more features into chipsets and motherboards, we started adding more USB ports and video ports, and at some point it seemed like adding a second network port was a good idea. I've never used both network ports at the same time (though once, one port failed and I was able to switch to the "backup" port). Which isn't to say that there aren't uses for a second network port; they're just pretty niche.

One option is port bonding, where the two ports appear as a single connection to the OS, and it can load-balance between them or failover should one port go down. Another option is port teaming, assuming you have a router/switch that supports it, where you combine two ports to potentially double the throughput. Some NAS devices support this, giving you potentially 2Gb/s instead of 1Gb/s, which can be helpful when transferring lots of data—though 10G would perhaps be better if you really need that much throughput. Or you could build a PC that acts as a powerful router/firewall, where one port connects to the Internet and the other services the home/work network—or a VPN or some other network.

In short, there are several uses, but most people never use the second port. Given the Internet connection is generally the largest bottleneck with regards to network performance, an increase in broadband speed is the first step, at least until you surpass gigabit speeds.

Virtually Aloof

I have respect for *Maximum PC* and its editors; however, I hope you are wrong concerning VR. I view VR with great skepticism.

The VR apparatus immediately impresses me as the technological equivalent of the opium den of the late 1800s.

The person immersed in VR is totally devoid of any interaction with anyone or anything else. Somewhat similar to the way some people are immersed in their mobile devices today.

I believe augmented reality to be the future; VR is not just a dead-end street, it is a catastrophic sinkhole.
—Bill McMullen

SENIOR EDITOR JARRED WALTON RESPONDS: Hi, Bill. I get what you're saying. I have a wife and three kids, and I tend not to use headphones for the same reason. When I put on some cans that block out the world, it's like no one can reach me. Alex commented after the latest Oculus Connect conference (http://bit.ly/MPC_VROC), "[VR is] the most anti-social piece of technology I've experienced, if we're talking about the physical room I'm sitting in." From an even higher level, we're already getting a ton of these isolated "opium den" experiences with the Internet, MMOs, games, and technology in general. We can sit in the comfort of our office chairs, and explore the world and hear about all the news, without ever having a real face-to-face interaction with another human.

There will be those who immerse themselves in VR and unplug from the real world, but most people are responsible. VR is something they will try, and it will generate new experiences and content, but when they feel too isolated, they will shut down the matrix, and go do something else. It's what I do with games, social media, and so on, and many others I know do, too. Alcohol, drugs, comic books, games, smartphones, and so on, haven't destroyed society, despite the fears of many parents and leaders, and VR won't either. Things will change, but we'll adapt. That's what people do.

While I view VR and AR as related technologies, I do think long-term you're right in that AR will become the more prevalent technology. VR may appeal to technophiles, but AR can do certain things better than VR—it's all in the name: augmenting reality versus replacing it completely. AR, for example, could project a heads-up display (HUD) on to your windshield that highlights traffic hazards, provides directions, and so on. But both technologies are in their infancy, and both offer a ton of potential. Until we reach the level of the *Star Trek* holodeck, there's room for improvement and innovation. There will be problems—technological and societal—along the way, but if we get too far off course, these things have a natural way of correcting themselves.

Facebook Polls

Upgraded to Win 10? What do you think?

Thang Tran: The good: speed and stability compared to previous versions. The bad: upgrading process. Why can't we do a fresh install right away without having to upgrade first? The ugly: Cortana, ugh.

DeWayne Durrett: Malware, plain and simple.

Isadore Besse: It runs well, but I don't like that they got rid of Windows Media Center.

Rick Baker: Waiting until first major update first. Never jump in right away. Too many programs are not ready for it.

Joe Bendezú: Muy bueno!

Douglas J. Hale: Fantastic, runs fast, faster boot, one of the best Windows ever.

Neil DiFranco: Makes my life and work so much easier! Better yet, combined with a phone running W10M, even if it is still a preview and running on old hardware. Anything that improves efficiency is great! Don't fear change.

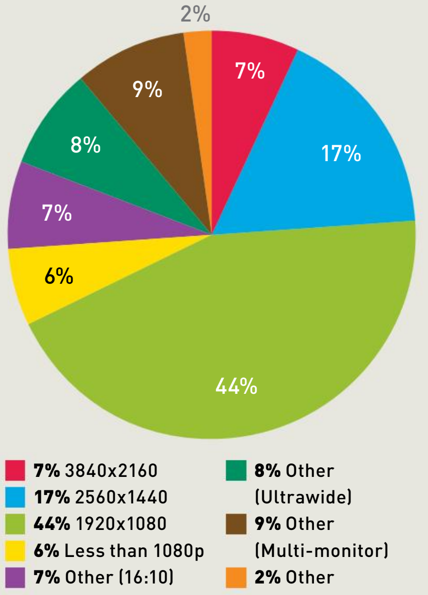
Jack Leclair: If it's not broken, don't fix it. Win 7 works and never had problems. I'll switch when I have to, maybe a few years before that happens.

David Booth: Simplest upgrade so far, left me feeling like I actually did get an upgrade.

Ross Goodfellow: I like it, but Fraps crashes continually, and when it does, games crash, too.

Matthew Orlandini: Love.

What's your screen resolution?



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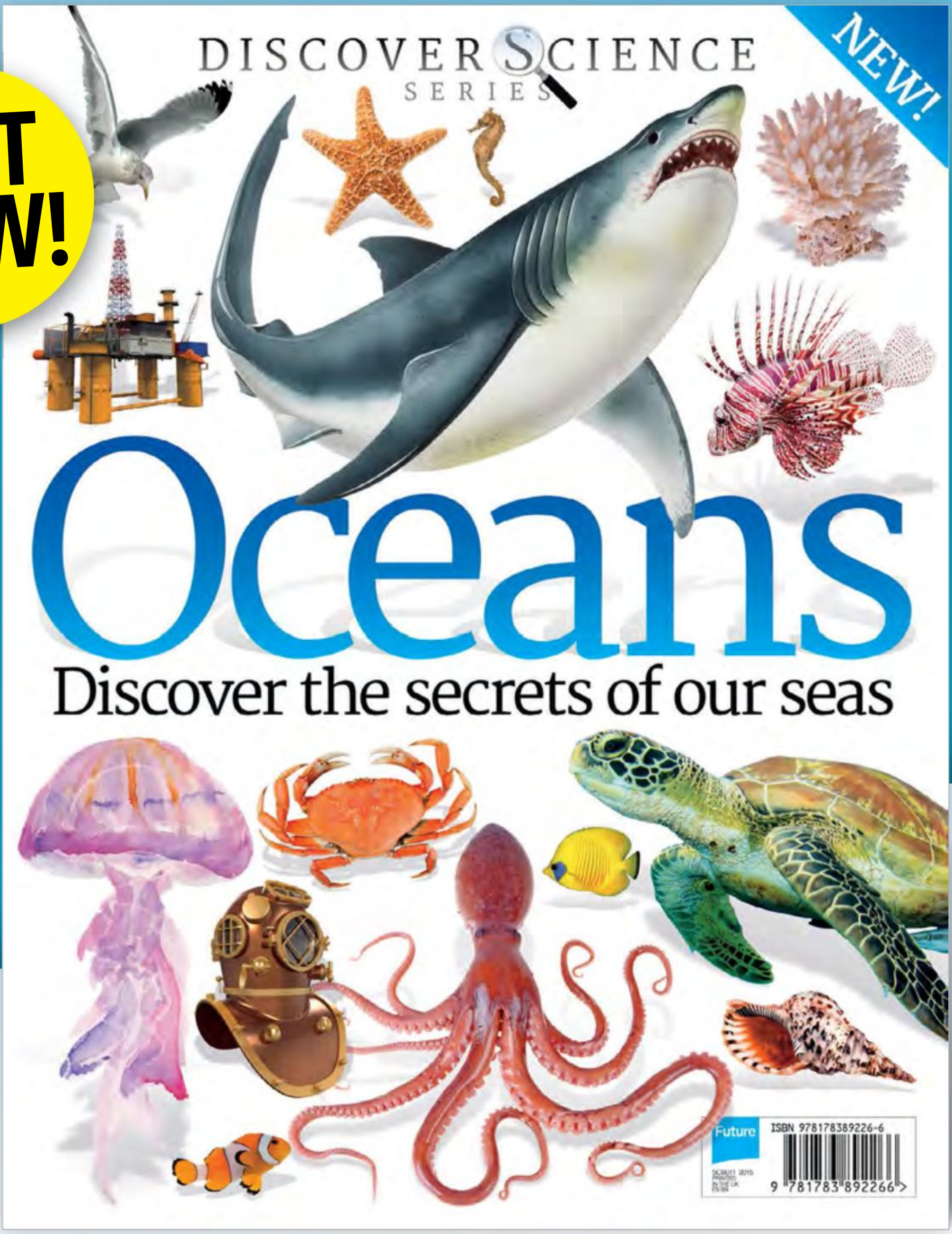
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THE BUILDS

BUDGET GAMER

INGREDIENTS

PART			PRICE
Case	Cooler Master Elite 110		$40
PSU	Corsair CS450M 450W/80 Plus Gold		$55
Mobo	Asus H170I-PLUS	**NEW**	$105
CPU	Intel Core i5-6500	**NEW**	$193
GPU	EVGA 1962-KR GeForce GTX 960 SC		$215
RAM	8GB (2x 4GB) Kingston HyperX Fury DDR4 2133	**NEW**	$54
SSD	500GB Samsung 850 EVO	**NEW**	$150
OS	Ubuntu Desktop Linux 14.04 LTS 64-bit		$16

Approximate Price: $828

WHEN PRICES FALL, you get more breathing room for power. Price drops for the PSU, SSD, and video card were small for each item, but represented a reduction of around $20 from last month's $843. The first thing to go was the motherboard. We replaced the ASRock mobo with the Asus H170I-PLUS. We like it because it shares many features of the Z97I-PLUS that we've put in other mini-ITX builds. Next up was the CPU. With a little breathing room, we went from the Core i5-6400 to the i5-6500. For less than four bucks, you get a near 20 percent clock increase, by going from 2.7GHz to 3.2GHz. The last change was to the memory. We spent three more dollars to get Kingston's HyperX Fury DDR4 sticks. The RAM timings (14-14-14) for these two 4GB sticks were better than some other modules in this class. (CAS latency timing is around 15 or so for most sticks.) The black DIMMs also keep the dark H170I looking more uniform.

MIDRANGE

INGREDIENTS

PART			PRICE
Case	Corsair Carbide 500R		$90
PSU	EVGA SuperNOVA G2 650W		$100
Mobo	Gigabyte Z170X-Gaming 3		$150
CPU	Intel Core i5-6600K		$270
Cooler	Corsair H80i	**NEW**	$90
GPU	Asus R9 390 Strix	**NEW**	$305
RAM	16GB (4x 4GB) G.Skill Ripjaws 4 Series DDR4 2133	**NEW**	$100
SSD	500GB Samsung 850 EVO M.2		$150
HDD	Western Digital Black Series 1TB		$65
OS	Windows 10 (Download)		$110

Approximate Price: $1,430

PRICE DROPS HELPED us wiggle a bit more with the Midrange as well. As prices dropped for the Carbide 500R, Samsung Evo, and WD Black, we got room for an upgrade, but not enough to jump to a Core i7 Skylake. We stuck with the Core i5-6600K Skylake, which is a fine CPU. To keep it cool, we changed from Corsair's H100i to the smaller H80i. The H80i gets results on a par with the NZXT Kraken X61, with a smaller radiator and push/pull fans. It's also cheaper than the H100i. The savings let us get another 8GB of DDR4. Many apps don't need 16GB, but it allows for more open browser tabs and Photoshop windows. We also picked up an Asus R9 390 Strix to push pixels. The R9 390 is in a similar price class as the GTX 970, but falls in between the GTX 970 and 980 in terms of performance. Finally, we made the leap to Windows 10. As this is an original install, we can't get it for free, so the price is for a key we could use for a downloadable copy of the OS.

TURBO

COMING IN AT JUST UNDER THE $3,000 budget limit, the Turbo gives you six cores and twin GTX 980Tis in SLI for $2,993. While the core theme of CPU, GPU, and motherboard choice stayed the same, we had some big changes in other components. First of all, we wanted to make sure there was as much headroom for overclocking as we could muster. To accomplish that, we added 150W to our PSU. With a full kilowatt, there's plenty of spare power to accommodate overclocking and additional cooling. Speaking of cooling, we went with the big, frosty NZXT Kraken X61. The 780T is a big case, and the Kraken feels right at home and offers plenty of room to spare. Luckily, prices fell for many of the parts, so we had some spare room for upgrades. And upgrade we did. Making the jump from 16GB to 32GB of memory cost us an extra $100, but it is money well spent to round out the top-notch specs of this build. For the nitpickers, there's one thing we're missing with this build: The Core i7-5820K lacks the full complement of SLI lanes. The next step up, the i7-5930K, is $70 more. On top of that, many argue that for dual-SLI, a total of 24 lanes is enough. However, if NVMe or a third card are to be considered, upgrading to the 5930K would become necessary.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best

INGREDIENTS

PART			PRICE
Case	Corsair Graphite 780T		$160
PSU	EVGA SuperNOVA G2 1,000W	**NEW**	$150
Mobo	Asus X99-A/USB 3.1		$235
CPU	Intel Core i7-5820K		$390
Cooler	NZXT Kraken X61	**NEW**	$140
GPU	2x Zotac GTX 980Ti		$1,260
RAM	32GB (2 kits of 4x 4GB) Corsair Vengeance LPX DDR4 2133	**NEW**	$200
SSD	1TB Samsung 850 EVO		$348
OS	Windows 10	**NEW**	$110

Approximate Price: $2,993

UPGRADE OF THE MONTH

ZOTAC GTX 980 AMP! EXTREME

While reference-model Nvidia GTX 980Ti cards are awesome, sometimes you have to go bigger. Zotac did that with the Amp! Extreme model of the 980Ti. If there's one big downside to using the big triple-fan card in a build, it would be its size. However, if you have the room inside your case for its three fans and triple-slot width, this card is blazing fast and keeps cool under pressure.

$670, **http://zotac.com**

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